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THE GAS JOURNAL

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A Glance at the Contents—

Glover-West Verticals at Maryport.

An account appears of the official opening of an installation of Glover-West continuous vertical retorts at the Maryport Gas-Works.

Death of Samuel Glover.

The death occurred on Sunday last of Mr. Samuel Glover, M.Inst.C.E., of St. Helens, Past-President of the Institution of Gas Engineers.

Engineer and Manager Required for Dunbar.

As will be seen from our advertisement columns, the Dunbar Gas Commissioners require the services of an engineer and manager, to take up duty about six weeks hence. The salary offered is £300 per annum, with free house, coal, and light.

Assistant to Gas Manager Required.

The Ilkeston Town Council are inviting applications for the position of Assistant to the Gas Manager. The salary offered is £200 per annum, rising by annual increments of £15 to £260 per annum. Full particulars will be found in our advertisement columns.

The Gas Unit.

Mr. W. W. Townsend, of Colchester, and Mr. G. Dixon, of Lancaster, give their reasons for suggesting that the introduction of a smaller unit than the therm would do more harm than good. Another correspondent puts forward the claims of the millitherm—100 B.Th.U.

Electricity on Gas-Works.

The Annual Meeting of the Manchester and District Junior Gas Association took place at Bolton, on Oct. 4, when over a hundred members assembled at the Works Offices of the Gas Street Works, and were received by the Gas Engineer, Mr. W. J. Smith, B.Sc., and the President, Mr. C. H. Bamber, B.Sc. After the usual business of the general meeting, Mr. Bamber delivered his Presidential Address. He dealt with the subject of the utilization of electricity on gas-works. Almost every gas-works nowadays, he said, uses electricity in some way or other for power, or for lighting in dangerous situations. Yet how many officials in the gas industry have more than a rudimentary knowledge of electricity?

Uniform Calorific Value.

In our correspondence columns to-day Mr. J. Mogford replies in no uncertain terms to "B.Th.U.'s" article on this subject last week.

A Jubilee at West Bromwich.

On Thursday, Oct. 9, the West Bromwich Gas Department celebrated their Jubilee, when the members of the Town Council, officials, and a number of guests paid a visit to the gas-works at Albion, and were afterwards entertained at tea at the new showrooms. The present annual output of gas from these works is 531 million c.ft.

Gas-Works Practice at Wolverhampton.

In his Presidential Address before the Midland Junior Gas Association, Mr. William Macnaughton, Assoc.M.Inst.Gas E., Assistant Engineer to the Wolverhampton Gas Company, gives some working results and details of the plant at the Wolverhampton Works. He describes the reinforced concrete purifiers erected by the Company in 1919, and also a Neckar water softening plant.

Sales in the Smaller Undertakings.

Mr. J. Corrigan, Engineer and Manager to the Penrith Gas Department, in a paper which he read before the Cumberland and Westmorland Gas Managers' Association last week, deals with the development of business in small undertakings geographically isolated. His remarks show him to be an optimist of the right stamp; he minimizes neither his obstacles nor the forces at his command. He outlines the remarkable progress made in Penrith of recent years, and urges our industry to give proper attention to the lighting business, both domestic and public.

Art in Industry.

In an article on this subject, Mr. S. B. Chandler, of Tottenham, maintains that the tasks of the workman would become more interesting were he to appreciate in his everyday surroundings some form of beauty. "The interest and enthusiasm aroused by his new vision would help him immeasurably in performing the routine matters of business, and would foster originality and individuality of expression." And Mr. Chandler believes that much good can be done in this respect by pictorial presentation of surroundings viewed by an artist. The subject is dealt with editorially in our columns to-day.

EDITORIAL NOTES

Outside Producers

As far as we are aware, there are only four gas undertakings in this country where mechanical producers are employed for making gas for heating carbonizing settings, in spite of the advantages of having a supply of clean heating gas subject to very close regulation, and the elimination of the heavy manual attention to the static producers. The trouble so far has been the high capital cost of external producers *plus* recuperators. Carbonizing conditions, however, have undergone a marked change due to the extended application of waste-heat boilers and the consequent increase in available breeze. No true comparison can be drawn between the costs of static and mechanical producers without bearing this in mind, and also crediting the latter form of plant with the savings due to the employment of clean and easily-regulated gas of constant composition. The position is not yet quite clear, but it has been rendered very much clearer by the work of Mr. A. L. Holton (Chief Engineer) and Mr. H. C. Applebee (Chief Chemist) of the Manchester Corporation Gas Department, who describe in our issue to-day the results of experiment with the Trefois producer itself and with the heating of retort settings. They have put forward an exceedingly good case for the mechanical producer, though we should have liked to see a few figures of the capital costs of the plants they deal with. The account loses much by their omission.

Briefly, the experiment with outside producer gas was commenced in May, 1925, at the Bradford Road Gas-Works, Manchester, when a Trefois producer capable of a daily output of 1¾ million c.ft., and so flexible as to be operated successfully to give a make of 100,000 c.ft. a day, was installed. Sundry improvements were effected; and the plant, as now constructed, "works very satisfactorily, and there is no ash or clinker trouble whatever." The gas is purified by water and anthracene oil, and experiments are in hand to simplify the cleansing process. The producer has been successfully operated on practically all grades of coke breeze; a breeze containing up to 40 p.ct. passing through ¼-in. mesh having been utilized with complete satisfaction. Moisture and ash have little, if any, effect on the working of the producer. The total cost per 1000 c.ft. of producer gas made by the plant at Bradford Road during the years ended March 31, 1928, 1929, and 1930, averages 1·1d., and this includes repairs and maintenance. It seems that the authors do not include the cost of anthracene oil used. Perhaps there is an explanation of this; at any rate, the quantity of oil used is very small, amounting to 1½ to 2 gallons per million c.ft. of producer gas. The experiments at Bradford Road justified the installation of six Trefois producers at the Partington Works; and the working costs of this plant, which cannot include repairs and maintenance, but which show a separate item for anthracene oil, are given as 1·01d. per 1000 c.ft. The wages bill at Partington amounts to 0·26d. per 1000 c.ft. (nine operators to attend to the six producers).

The authors' description of the experimental work carried out at the Bradford Road Works on the use of clean producer gas for heating horizontals is most interesting. One setting is the normal Drakes type retaining the normal tubular regenerator. In this case, half the producer gas and half the air respectively enter on each side of the regenerator, both being heated by the waste gases in the usual way. The other setting has, in addition to the ordinary type of regenerator, a special regenerator for heating the producer gas built into position formerly occupied by the producer. No difficulty has been experienced in working either pattern of setting. At Partington, the settings are of the second type. While cold air and cold producer gas are not likely to give a sufficiently high temperature in the combustion chamber, the authors express their belief that preheating either to 600° C. gives sufficient margin, and state that there is every justification for the experiment of using regenerated air and cold producer gas on the lines they indicate. The main conclusions set out by Messrs. Holton and Applebee are as follows: The Trefois producer has proved completely satisfactory for the manufacture of producer gas from materials which would otherwise have been practically useless; the control of the plant is simple, its efficiency at all loads high, and its flexibility as regards both material and output very great; the cost of manufacturing the producer gas is low, and its use for heating the retort settings represents substantial economies in the cost of carbonization. And they advance, among the advantages of gas-fired settings, these facts: An alteration in the design of the setting resulting in lower capital costs; simpler operation of the setting; greater measure of control; longer life of settings; lower operating costs; no loss of fuel in the ashes, as with the usual type of "built in" producer; and the utilization of a cheap fuel.

During the discussion on the paper—a discussion which brought forward many appreciative references to the pioneer work of the authors—Mr. H. E. Bloor, of York, mentioned that he intends to install a Trefois plant in his own works, so impressed has he been with the success which has attended the series of experiments carried out at Manchester. Incidentally, he paid tribute to the generous manner in which the Manchester Gas Department at all times offered every facility to the engineers of other gas concerns to become acquainted with the new form of producer plant and with the results of their investigations.

Facing-Up to Tar Problems

FOUR weeks ago in his William Young Memorial Lecture, Sir Arthur Duckham urged the Gas Industry to concentrate more on the problems associated with tar. On this occasion he pointed out that an increase in the price of tar amounting to £1 per ton would mean an increased revenue to the Gas Industry of over one million pounds per annum. He further urged that much more research work on tar should be undertaken. That Sir Arthur practises what he preaches is shown by the paper on "Some Problems and Suggestions Relating to Coal Tar," which is being presented to the Eastern Counties Gas Managers' Association to-day by Messrs. W. J. Chadder and H. M. Spiers, of the Woodall-Duckham Companies. This paper (to be found in the "Technical Record" of the present issue of the "JOURNAL") sets out in detail a considerable amount of unpublished research work on the subject of tar, with special reference to the production of road tar of uniform quality from varying raw materials.

In the first part of their contribution, the authors discuss the difference in the nature of tar, resulting from differences in the carbonizing conditions. There is a decided trend in the various properties in the sequence horizontal retort tar, coke oven tar, intermittent chamber tar, vertical retort tar, and low-temperature tar. The general tendency along the series is a decrease in the specific gravity of the tar and of the corresponding distillates, a decrease in the free carbon and naphthalene contents, a decrease in the pitch content, an increase in the tar acid content, and an increase in the content of the medium boiling and high boiling oils. Analyses and distillation tests of nineteen typical tars covering the whole of this sequence are given in an Appendix. It is pointed out that tars produced by any one system of carbonization differ among themselves. Such factors as nature of coal, size of coal, and carbonization temperatures, all influence the properties of the tar produced. The subject of tar handling on the gas-works is briefly dealt with, emphasis is laid on the advantages which have followed the adoption of liquor spraying in the foul main, and it is urged that tar and liquor separation should be carried out

while they are hot, since separation is then more rapid and complete.

But by far the most important section of the contribution is that which discusses ways and means by which varying tars may be converted into a road tar of uniform quality, conforming to the requirements of the user. Messrs. Chadder and Spiers evidently regard this point of "uniformity" as the keynote of the present situation. They say: "What success bitumen has achieved is certainly not due to its superiority over properly prepared road tar as a material for road construction. It has largely come about as a result of intensive advertisement, a lively interest in the material on the part of producers and distributors, and a striving after a uniform product." If it be accepted that a uniform road tar must be produced, the question immediately arises: To what specification shall it be made? In this matter we are at the present time, in the opinion of the authors, in a transitional stage; for "we are far from knowing what are the essentially valuable physical properties of tars from the point of view of the road industry, particularly as regards assigning numerical limits to these properties for specification purposes. Ductility, penetration, cementitiousness, and durability and resistance to oxidizing conditions, actinic rays, and extremes of temperature are all of importance."

The pioneer work in the construction of tarred roads was carried out with horizontal retort tar, and "it is a fact that the vast majority of crude horizontal retort tar is readily convertible into satisfactory road tar." It is therefore almost inevitable that the characteristics of horizontal retort road tar should have largely influenced the drafting of the Standard Specifications for road tar. But during the past few years there has been a rapid increase in the amount of tar produced from continuous vertical retorts, now amounting to 65 p.ct. of the total tar produced in British gas-works. The question therefore arises: Can vertical retort tar be converted into a satisfactory road tar? The answer is that many million gallons have been converted into road tar with completely satisfactory results. But the process of treatment must be modified. For modern traffic conditions, road tar must have a high consistency, as well as a rapid drying rate. In the case of vertical retort tars high consistency is generally obtainable only by the removal of a larger proportion of the distillates than in the case of horizontal retort tars. The consequence is that the readily evaporable oils have been removed, thus causing the slow drying properties of some vertical retort tars. But both high consistency and high rate of drying in the case of vertical retort tars can be obtained by a simple process which the authors describe in the paper we are considering.

The principle underlying this process is that the distillation characteristics of tars, as well as other properties, can be modified by the blending of light residue tars with heavy residue tars. It is thus possible to prepare from a given tar a series of road tars having the same consistency, but widely different distillation characteristics. In brief, the process consists of blending a certain quantity of light residue tar and a certain amount of heavy residue tar, both produced from the same original tar; the proportions of the constituents being such that the mixture has the same consistency as would a straight-run tar, but contains a higher percentage of lighter oils. According to figures included in the paper, this process is producing road tar conforming in every respect to the requirements of the Standard Specification from tars which would not yield a satisfactory tar by a single straight-run distillation.

The authors do not claim that the process is a panacea for all troubles, but they do say that the blending method will give improved drying properties with all road tars produced from vertical retort tars. This new process should be a useful means of securing uniformity of product, which, as we have already mentioned, is of supreme importance in the matter of road tar. To sum up, the paper faces-up to the problems associated with tar, and the authors are to be congratulated upon offering concrete suggestions for improving the present position. The prosperity of the Gas Industry as a whole, and of each individual gas undertaking, is to quite a large extent bound up with this matter of tar. If the paper helps the industry to face the facts concerning tar, it will have served a most useful purpose.

"Isolation"

An inspiring paper of unusual import was read by Mr. J. Corrigan, Engineer and Manager of the Penrith Gas Department, before the Cumberland and Westmorland Gas Managers' Association on Friday last. Broadly, gas undertakings in Great Britain may be divided into three classes: Large concerns, adjacent small ones, and "isolated" small ones. To the second category the first resembles an octopus, with the qualification that it is a constructive octopus instead of a fish which absorbs its prey for its own benefit—in any event it has tentacles, and necessarily so in modern circumstances. Until recently the "isolated" concerns have been immune from serious competition from any other refined energy in the fields of lighting, heating, and cooking, and they have had no need to exercise themselves about tentacles. Even to-day there are areas in this country—that covered by the Cumberland and Westmorland Association provides an excellent example—where the tentacles of larger gas undertakings cannot sway, but where, nevertheless, the tentacles of electricity are rapidly drifting. We have from time to time many interesting accounts of the working of large concerns and of adjacent small ones, but we hear comparatively little about the "isolated" small undertakings and their peculiar difficulties and advantages; hence the excellent paper by Mr. Corrigan is more than welcome.

We have quoted the word isolated for a definite reason—that nowadays such an adjective is comparative rather than absolute. No gas undertaking to-day need feel isolated, if only because it has in the background the resources of such organizations as the British Commercial Gas Association. Moreover, the idea of co-operation is gaining ground; it is being realized that co-operation is essential to individuality, and that the team-work spirit is necessary if competition from electricity is to be withstood. This idea is well appreciated by Mr. Corrigan, who, though he understands the value of newspaper advertising, remarks that it is expensive for a small works, and suggests that certain areas covered by the Cumberland and Westmorland Association are suitably placed for a joint advertisement to be run by the interested undertakings. This would be a very effective method of demonstrating the co-operation between those gas undertakings, and at the same time would prove a useful backing to the national advertising of the "B.C.G.A."

Throughout his paper, the author shows himself an optimist of the right stamp; he minimizes neither his obstacles nor the forces at his command. Properly drilled and trained, the forces of the so-called isolated undertaking are by no means weak. As Mr. Corrigan observes, though the small works lack the elaborate showrooms and the extensive local advertising at the command of the larger works to bring the service of gas to the notice of their consumers, they do possess the great advantage of being more easily able to establish, through their management, personal contact and confidence. It is impossible to evaluate in sterling the worth of this asset, but it is unquestionably great. As for the fundamental of good gas service—uniform gas distributed at adequate and constant pressure—there is no reason, given an enlightened directorate or committee, why the small undertaking should be in an insecure position. As Mr. J. E. Blundell, Engineer at Carlisle, pointed out in an address to the Association which was published in the "Journal" for Sept. 25, 1929, the very nature of gas production renders it possible for the small works to be as thermally efficient as the large works; and it has been proved in practice that there are many small undertakings as commercially efficient as the larger ones.

The account of Penrith's progress during the past ten years is a veritable tonic. There has been an increase in gas consumption of 50 p.ct., and, what is more important, the average consumption per consumer has grown from 22,000 c.ft. to nearly 28,000 c.ft. Obviously this result has not "just happened;" it is due to effort; and the means adopted by Mr. Corrigan to develop his business make excellent reading. He believes, of course, in cheapness as one of the major strongholds of our product. Naturally, he says, each undertaking must offer its gas at the lowest possible economic rate—"but only after the reliability of supply has been assured." And we agree with

the author that it is a mistake to assume that the undertakings supplying the cheapest gas are necessarily in the soundest position to meet competition. They have, no doubt, a great advantage, but the deciding factor will be the quality of their service to the consumers. As for the development means mentioned, we call particular attention to the author's experiences of the virtues of exhibitions and demonstrations of the domestic applications of gas in rural areas, of his faith in the provision of flexible hiring and purchasing facilities for the less wealthy consumers, and of his belief in the efficacy of looking after the lighting load—selling, as well as talking, modern lighting, both domestic and public. We will conclude our brief review of Mr. Corrigan's paper by a quotation, which is undoubtedly worthy of emphasis: "It is quite certain that any undertaking that really means now to make a fight to retain the lighting load is in a far better position than it was a few years ago. The general manufacturing standard of gas lighting burners has been greatly improved, and the adaptation of the distance control devices and switches, together with the new artistic and decorative effects, has produced quite a different outlook for the future of gas lighting."

Art in Industry

LET it be said at once that we approach the subject of art in industry cautiously, but not timorously; for though the horse temporarily mounted has necessarily long legs, they are not so long that the rider's head must be in the clouds. In our view, art is more essential to man's welfare than are his trousers; and both art and trousers are practical. When a man orders the latter, the transaction is a simple one; when he orders art, the matter is more complicated, and all manner of unnecessary jargon and hazy thinking are apt to be indulged in. Many, indeed, boggle at the task, greatly to the detriment of themselves and of the noble army of artists (we almost said martyrs), who are thereby either marooned in a society of hard-headed economists or else suffer incalculably from over-idealization. Leonardo da Vinci was a first-class plumber, and Benvenuto Cellini, were he alive to-day, would be capable of handling a gas-fired muffle furnace quite as well as a competent industrial gas salesman—though he might, it is true, smash the whole installation if the gas pressure had to fall below temperature requirements. Not every plumber or gas salesman can be an artist, but all could—were they to rid themselves of a baseless "practical complex"—learn to enjoy art. And enjoyment, to our mind, is what life is for.

There is need for greater sanity of outlook on this subject of art in industry. On all sides we hear addresses on co-partnership and the like schemes, to enhance the welfare of the worker, to lend greater enjoyment to his employment; seldom, however, is anything heard about widening the worker's vision of this employment. For this reason, we welcome an article by Mr. S. B. Chandler, of the Tottenham and District Gas Company, which is published in later columns of our issue to-day. How much more interesting, he maintains, would his work become were the workman to appreciate in his everyday surroundings some form of beauty. "The interest and enthusiasm aroused by his new vision would help him immeasurably in performing the routine matters of business, and would foster originality and individuality of expression." And Mr. Chandler believes that much good can be done in this respect by pictorial presentation of surroundings viewed by an artist.

That there really is art in industry has been demonstrated by thoughtful and far-seeing artists who have recorded impressions of beauty in what would be considered most unpromising environment. Such an artist is Mr. Herbert J. Finn, whom we had the privilege of visiting in his Chelsea studio a few days ago. He showed us many of his pictures of industrial subjects, including a whole series of the Tottenham Gas-Works. These paintings are the finest of this type which we have ever seen; the draughtsmanship is superb, and the pictures have much feeling. Technique of a very high order is allied to such an understanding of the functions of apparatus as would satisfy the purist engineer. These paintings ought to be seen by as many as possible in our industry; and we may mention that the opportunity exists, for Mr. Finn's remarkable work can be seen at an exhibition which is being held from to-day till Oct. 25 at the Alexandra Palace, Wood Green. Those who see his pictures will ask themselves, "Are gas-works really like this?" And they will receive a satisfying and reassuring reply.

We ought to try to cultivate a greater sense of colour and form values, for beautiful pictures abound everywhere—even among mill chimneys. We well remember Sir Michael Sadler describing a time-table board which he saw on the station platform at Normanton. The time-table had been partially erased by a porter prior to posting another in its place. The effect of massed blacks, delicate greys, and specks of white was that of a waterfall in a ravine; and it gave enjoyment to the beholder. We record this as an example of what we believe Mr. Finn means when he says there is beauty everywhere; and we leave our readers to find proof of his interpretation of form and colour at the exhibition to which we have drawn attention.

Something for Nothing

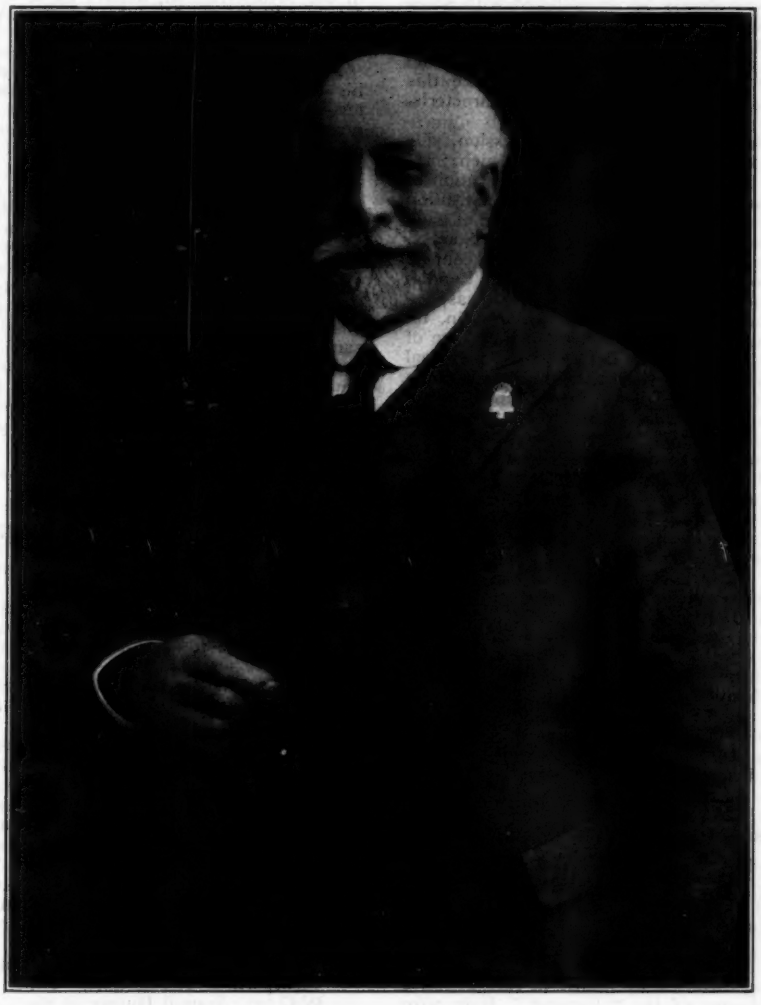
THOUGH experience provides one with conclusive evidence, right along from the first dawn of understanding until the final change from twilight to darkness, that never in any circumstances is it possible to get in life "something for nothing," yet there is assurance from Sir Walter Raine, in his Presidential Address to the autumn meeting of the Association of British Chambers of Commerce, that "the ever-increasing tendency to seek something for nothing is a regrettable feature of present-day conditions." Assuming that this is a correct diagnosis, there are evidently vast numbers of people who gain nothing from that best of all teachers. Such a tendency to seek a "will-o'-the-wisp," in the matters to which the address refers, must have a far more devastating effect than merely that of leading the individual into a morass; for Sir Walter says that, "under its hypnotizing influence, many employers, as well as many wage earners, have been lulled into thinking that working hours and general diligence are not so important now as they were once upon a time."

One can only hope that these misguided people may be brought, before it is too late, to full realization of the fact that, so far from effort being less important to-day than formerly, what is wanted is more faith, more hard work, more energy, more enthusiasm, more of everything which can go towards the securing of what we all desire, greater prosperity for the country, and greater happiness for ourselves. It is not in one direction, but in all, that this added effort is called for, and will bring its reward. Modesty shall not, however, prevent us from singling out that particular sentence of the address in which Sir Walter Raine said: "In these bad times, instead of cutting-down expenses in every direction, people should rather increase their account for advertising, as by so doing they ought to increase their business."

OBITUARY

SAMUEL GLOVER, M.Inst.C.E.

At the beginning of May last, the friends of Mr. Samuel Glover throughout the industry in which his life had been so usefully spent were grieved to learn from an announcement appearing in our pages that he was suffering from severe heart trouble. Subsequently he recovered sufficiently to make short excursions by car into the country, and to walk slowly in the garden; but the functioning of the heart gradually failed, and the end came last Sunday, after many weeks' confinement to his bed. All of us in the industry must feel deeply the loss of a good friend, and with our sorrow is mingled sympathy with those whose bereavement is even greater. As husband, father, brother, or friend, Samuel Glover possessed qualities which won both love and respect. No one who needed help which it was in his power to afford found him unresponsive. Alike at business meetings and social functions his genial manner was such as to keep the memory of him green for many a year to come.



SAMUEL GLOVER, M.Inst.C.E.

Mr. Glover passed peacefully away at his residence, Olive Mont, St. Helens, at the age of 73. The funeral will take place to-day at St. Helens Cemetery, after service at the Congregational Church. He was a St. Helens man by birth and upbringing, and received his early training under the Managers of the St. Helens Gas Company, and was transferred along with the works to the Corporation upon the purchase by them of the undertaking. He served under two Managers, Mr. Wm. Pritchard and Mr. Jos. Hall. On the death of the last-named, Mr. Glover was appointed Engineer and General Manager in 1887—a post which he occupied with distinction till 1920.

In August, 1911, to commemorate the forty years' service of Mr. Glover and to testify their esteem for Mrs. Glover, there was a pleasant gathering of about two hundred of the officials and workmen of the St. Helens Corporation Gas Department. The Chairman on this occasion (Mr. R. Sterritt) said they had every reason to be proud of Mr. Glover, who had steered the ship for a good many years in a very successful manner, and they were also pleased to have with them Mrs. Glover, because they knew how great was the interest she took in their welfare. Though Mr. Glover had been with them so long, his energy had not abated in the least, and his ability was greater than ever. Not only did the St. Helens Corporation acknowledge this, but it was acknowledged throughout the country. There was presented to Mr. Glover a handsome illuminated address, and to Mrs. Glover a massive salver suitably inscribed.

In October, 1917, after 45 years' service with the Corporation, Mr. Glover would have been entitled to retire on a superannuation allowance, but, feeling anxious to do what, in the difficult times through which the country was then passing, would be best in the interests of the undertaking, he offered to remain at his post until calmer days arrived. When peace finally came, the Council, having again considered the matter, asked Mr. Glover to continue his work with an addition to his salary. As we remarked at the time, such a proof of confidence, after having served the Gas Company and Corporation for 47 years in the same works, must have been highly gratifying to Mr. Glover, as it certainly was to his friends—particularly as the Corporation were pleased for him to take all the interest he desired in serving the gas industry in every way he could.

It was in December, 1920, that Mr. Glover intimated to the Gas Committee his desire to be relieved, as from May, 1921, of his duties. He thus left his post with fifty years' continuous service to his credit. On his retirement it was resolved that he should act in the advisory capacity of Consulting Engineer for the Gas-Works for a period of twelve months.

In connection with Mr. Glover's retirement after half-a-century of service, there was a gratifying ceremony at St. Helens, when Alderman Crooks (Chairman of the Gas Committee) called upon the Mayor to make a presentation of an inscribed gold

watch to Mr. Glover, and a handsome silver salver to Mrs. Glover. The inscription on the watch was: "County Borough of St. Helens. Presented to Samuel Glover, Esq., M.Inst.C.E., by members of the Council on his retirement after fifty years' faithful and efficient service, as a mark of appreciation." The Mayor remarked that it was one of the most pleasant duties that had ever fallen to his lot.

Another presentation was made at a meeting of the Council of the Institution on June 29, 1921, when it was resolved that the sincere congratulations of the Institution of Gas Engineers be tendered to Mr. Glover, "on his attainment on May 1, 1921, of fifty years' continuous service in the Gas Department of the Corporation of St. Helens and in the St. Helens Gas Company as a pupil, Assistant, Deputy Engineer, and Chief."

The following was put on record at the foregoing meeting:

"The Council desire to record their appreciation of Mr. Glover's unceasing efforts on behalf of the gas industry generally, especially in the important detail of carbonization. The services he rendered to various Government Departments during the Great War, and also since the declaration of the Armistice on Nov. 11, 1918, will always be remembered with satisfaction. The Council express the hope that in his retirement from the position of Engineer and General Manager at St. Helens, Mr. Glover may long be blessed with good health, and retain the close friendship of his colleagues, who take this opportunity of expressing their sense of his genial characteristics and professional attainments."

Deceased attained high honours in the gas profession, side by side with his brother Mr. Thomas Glover, of Norwich. He was a Past-President of the Manchester District Institution of Gas Engineers and in 1918-19 was President of the Institution of Gas Engineers. He was a Member of the Institution of Civil Engineers, and a Fellow of the Royal Microscopical Society. He was for some time Examiner in Gas Engineering in connection with the Examinations of the City and Guilds of London Institute; and at the time of the Ilkeston gasholder disaster—in January of 1912—he was called on by the Corporation, together with Mr. J. Ferguson Bell, to report as to the cause of that serious accident. His interest in the enrichment of coal gas by oil gas brought him into contact with the late William Young, which resulted in a lasting friendship and much technical discussion on naphthalene troubles and their solution, visits to oil works, schemes for overcoming the anticipated difficulties in carbonizing English coals in vertical retorts, the taking out of joint patents, &c. The death at this stage of Mr. Young, and the urgent need for putting the scheme into practice, brought Mr. Glover and the firm of Wests together, with results which are well known. The Glover-West vertical system of continuous carbonization is now installed throughout the world.

During the war Mr. Glover superintended the stimulation of benzole and toluole production over a large district, and later gave valuable assistance in the Coal Control Department, helping to secure supplies of suitable coals for gas-making in Scotland and elsewhere. His recreations were of a quiet kind—gardening, reading, and Nature studies by the use of the microscope.

Our sympathy is extended to his widow and family, one of the members of which, Mr. Ronald B. Glover, is actively associated with West's Gas Improvement Company.

LOUIS F. TOOTH, M.B.E.

The death has occurred of Mr. Louis F. Tooth, Chief of the Gas Sales Department of the Commercial Gas Company, who passed away at Westcliff on Wednesday last, Oct. 8, and was interred at the City of London Cemetery on Saturday, Oct. 11.

Mr. Tooth's activities in the direction of the industrial applications of gas—*e.g.*, burners, sugar and varnish boilers, metal heating and melting furnaces, &c.—have at various times been recorded in the columns of the "JOURNAL," from 1910 onwards. His war-time activities in connection with the melting of metals and munition bronzes, &c., for which he was awarded the M.B.E., are reflected in a lecture which he gave before the London and Southern District Junior Gas Association (of which he was a Past-President) in April, 1920. This was reported fully in our issue for April 27 of that year. From 1915 till the end of the war he acted as Technical Adviser to the Non-Ferrous Metal Section of the Ministry of Munitions, supervising and controlling the manufacturing operations of a large number of works in London and other parts.

At the opening of the showrooms of the Commercial Gas Company in Poplar—that was in February, 1925—the late Mr. H. E. Jones spoke of Mr. Tooth as "a live wire; he is very active and full of energy. The Company's gas is used for melting gold and silver at the Mint; and Messrs. Rothschild also treat precious metals in gas furnaces—many of them Mr. Tooth's own inventions."

The death has occurred suddenly of Mr. JOSEPH DOAK, Lighting Inspector for Greenock. Deceased was a native of Greenock, and started his apprenticeship as a gasfitter with John McJannett & Co., Newton Street, completing his time with Mr. H. McP. Watson, Sugarhouse Lane. In February, 1905, he entered the services of the Greenock Corporation as foreman lamplighter, and when the Public Lighting Department was formed in 1919 he was appointed Inspector. During his time, he saw many changes and extensions of the burgh lighting system. He was a most popular official and by his abilities brought his Department up to a high state of efficiency.

PERSONAL

Mr. JAMES DICKSON, Manager of Dundee Corporation Gas-Works, who was granted four months' sick leave, is to resume his duties to-day. We are pleased to say that he has now quite recovered from his recent illness.

Mr. W. J. LIBERTY, Acting Hon. Secretary to the Association of Public Lighting Engineers, who has gone for a cruise in the Mediterranean, desires us to state that his address in future will be 64, Victoria Street, S.W. 1, and not 68, Victoria Street, as formerly.

Mr. ALEXANDER DUCKHAM has just returned from a visit to his oilfields in Trinidad, which island, by the way, is the largest producer of petroleum in the British Empire. The main object of his visit was to investigate the high-pressure gases which have hitherto rendered production from deep sands not only very problematical but also hazardous to life. The fact that the pressure registered on the surface in some cases exceeds 2000 lbs. per sq. in. will give some idea of the immensity of the problem. Mr. Duckham reports that the introduction of muds—superweighted with heavy powders such as barytes—has gone far towards harnessing these pressures; and consequently greater productivity will probably result therefrom. Wells explored to greater depths have shown that oils exist in greater quantities considerably deeper than the sands at present under development. The deepest exploratory well so far is more than 6000 ft., and even that has not exhausted the depth of the petroliferous formation. One cannot over-estimate the value of these investigations carried out by Mr. Duckham, who was one of the pioneers in the Trinidad oil industry.

Forthcoming Engagements.

Oct. 16.—SOCIETY OF BRITISH GAS INDUSTRIES.—Meeting of the Council in the afternoon.

Oct. 18.—WESTERN JUNIOR GAS ASSOCIATION.—Visit to the Writhlington Collieries, Radstock. Paper by Mr. K. L. Clark (Weston-super-Mare), entitled "Reflections of a Gas-Works Chemist."

Oct. 18.—YORKSHIRE JUNIOR GAS ASSOCIATION.—Annual General Meeting in the Lecture Room of the Fuel Department of the Leeds University, 3.15 p.m.

Oct. 20.—INSTITUTION OF GAS ENGINEERS.—Meeting of Joint Committee of the Institution and Leeds University, 2.15 p.m., at 28, Grosvenor Gardens, S.W. 1.

Oct. 21.—INSTITUTION OF GAS ENGINEERS.—Meetings of Liquor Effluents Sub-Committee, 10 a.m.; Ammonia Sub-Committee, 11.30 a.m.; General Research Committee, 2.15 p.m., at 28, Grosvenor Gardens, S.W. 1.

Oct. 22.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS (EASTERN DISTRICT).—Committee Meeting 11.30., General Meeting 2 p.m., at 28, Grosvenor Gardens, Westminster, S.W. 1.

Oct. 22-23.—INSTITUTE OF FUEL.—Annual Conference at the Incorporated Accountants' Hall, Victoria Embankment, W.C. 2. Annual Dinner at the Connaught Rooms, Great Queen Street, W.C. 2, on Oct. 22.

Oct. 23.—COKE OVEN MANAGERS' ASSOCIATION.—Annual Dinner at the Hotel Great Central.

Oct. 24.—LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.—Opening Meeting at the Westminster Technical Institute, 7.30 p.m. Presidential Address of T. H. Prater, M.Inst.Gas E.

Oct. 25.—MIDLAND JUNIOR GAS ASSOCIATION.—Visit to Works of Messrs. C. & W. Walker, Ltd., Donnington, Salop.

Oct. 25.—WALES AND MONMOUTHSHIRE JUNIOR GAS ASSOCIATION.—Meeting at Swansea.

Oct. 27 to 29.—BRITISH COMMERCIAL GAS ASSOCIATION.—Annual Meeting at Hull and Bridlington.

Nov. 6.—MIDLAND ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—Meeting at Grand Hotel, Birmingham, 2.30.

Nov. 19.—SOCIETY OF BRITISH GAS INDUSTRIES.—Autumn General Meeting in London.

Nov. 21.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—General Meeting in London.

Nov. 25-26.—INSTITUTION OF GAS ENGINEERS.—Autumn Meeting at the Incorporated Accountants' Hall, Victoria Embankment, W.C. 2.

CORRESPONDENCE

Self-Help in the Lighting Business.

SIR,—Mr. John H. G. Horstmann states that my remarks on distant gas switches cannot be entirely accepted. He then explains how unsightliness can be overcome on wall brackets by screwing the switch cock to existing tap, &c. Even when this method is employed, I still adhere to my previous statement that the "Noctus" switch is a comparatively neater arrangement when applied generally to wall brackets.

Further improvement to Mr. Horstmann's suggestion can be attained by designing the wall bracket with concealed tubes for the cable to pass through (similar to my description with drop pendants) and dispensing with the tap. We then have a nicely balanced fitting minus encumbrances.

The "Newbridge" switch is a most reliable distant control, and will assist the gas industry in proportion to its adoption.

This week we fixed three large open bottom bowls, with 3-light burners (No. 2 mantles) with concealed tube pendants in one dining hall. The bowls were of similar shape to that illustrated on p. 31 of last week's "JOURNAL," and the family was charmed with the effect.

These pendants have no unsightly taps or chains. The "Newbridge" switch cocks control the gas, and this is evidence of my faith in that excellent piece of work.

FREDERICK SHEWRING.

Gas-Works, Stratford-upon-Avon,
Oct. 11, 1930.

The Gas Unit.

SIR,—The correspondence which has appeared in the "JOURNAL" in favour of a smaller gas unit is of interest, but so far I am not fired with enthusiasm, and am tempted to ask "What is the matter with the cubic foot basis?"

I am one of those who believe that the introduction of the therm has done more harm than good. Why it was not sufficient to have guaranteed the quality and pressure of the gas, I do not know.

There is a danger—in our eagerness to discover ready ammunition to throw at our electrical friends—of baffling our consumer beyond his patience. By all means let the salesman study the relationship between the gas and electricity costs for the same work, but Heaven forbid that he should attempt to explain the matter technically to the consumer!

The greatest asset of the salesman is to be able to visualize the problem from the consumer's standpoint. I commend the suggestion that all appliances should be stamped at their rated consumption per hour, but whether a new gas unit is accepted or not, it will be necessary to exercise a little mental calculation to arrive at "all the consumer cares about"—the cost per hour under local price and conditions.

The matter of comparison between gas and electricity is, of course, not nearly as simple as would be suggested by those of your correspondents who are in favour of a comparative gas unit. Efficiency, maintenance cost, life, time factor, &c., are all to be reckoned in, while running costs in these days of block systems and two or three part tariffs have to be worked out individually, and are not constant even for the same appliance on different consumers' premises.

Our future is not, in my opinion, based upon a smaller gas unit, but upon the intelligent salesman with a keenness for his job, a good knowledge of his subject, more than a sprinkling of tact, and a happy "knack" of seeing the consumer's point of view. Given the right type of man and an honest case, he can be trusted to handle the gas sales in the face of all competition—with the gas units already in existence.

GEO. DIXON.

Lancaster,
Oct. 6, 1930.

SIR,—I sympathize entirely with the views of Mr. Keillor and with the objects which prompted Radiation, Ltd., to suggest the introduction of a smaller selling unit, but I consider that the proposal would only make "confusion worse confounded." The public are already sufficiently bewildered; they have heard of two different kinds of unit, one of which is the British Thermal Unit, another the Board of Trade Unit; they also know that their gas meters register cubic feet, and that they are charged by the therm. If to this is to be added another incomprehensible unit which is not the same as either of the others, the man in the street will be inclined to think that the object is merely to mislead him.

There is a further drawback which is clearly shown in the table set out in the letter from Radiation, Ltd., showing the equivalent cost of the gas unit. In order to save your readers the trouble of looking up the original letter, I reproduce the table:

	d.
With gas at 1s. per therm, the "Gas Unit" of 4000 B.Th.U. would cost	0·48
" " 10d. " " " " " " " " "	0·4
" " 8d. " " " " " " " " "	0·32
" " 6d. " " " " " " " " "	0·24

[To find the price of the "Gas Unit," multiply the price of the therm in pence by 4 and divide by 100.]

I do not think the majority of salesmen will agree that the introduction of the new unit would have the effect of simplifying calculations. The objection to decimals on the part of the average consumer is just as great as that of the late Lord Randolph Churchill.

It is, no doubt, a pity that when adopting the method of charging for heat units the industry did not ask for a smaller unit and one which could be more readily compared with the Board of Trade unit of electricity. It is, however, too late to lament this fact, and personally I cannot see that anything would be gained by adding another unit merely for the sake of comparison. Even if such a unit were to be adopted I strongly disagree with the suggestion that it should be 4000 B.Th.U. while the standard electrical unit is 3412.

In my view the consumer is not interested in technical discussions or technical expressions, and it is sufficient if the salesman tells the consumer in plain language the cost per hour in PENCE of running any appliance which is offered, or, in order to avoid the decimals, say what one pennyworth of gas will do.

W. W. TOWNSEND.

Gas-Works, Colchester,
Oct. 7, 1930.

SIR,—I have been most interested in the correspondence in the technical journals respecting the sub-division of the therm and the adoption of a gas unit of 4000 B.Th.U. In my opinion, neither the therm of 100,000 B.Th.U. nor a gas unit of 4000 B.Th.U. is very happy, as they do not appear to bear any relationship whatever to any other factor. In view of the interrelationship of the electrical volt, watt, and ampere, it is a pity that a thermal unit of a correlated quantity was not considered to work in conjunction therewith. A thermal unit of 3412 B.Th.U. is both clumsy and inconvenient, and, like the therm of 100,000 B.Th.U. and the gas unit of 4000 B.Th.U., appears to have no relationship to anything else.

Electricity is definitely charged on measurement in watts instead of thermal value. Gas is charged on a measurement in cubic feet converted into thermal equivalent. As a basis for charge the therm may not be unwieldy, but as a basis for comparison of consumption and output in regard to gas appliances it is, undoubtedly, clumsy, particularly when you have to figure it in decimal points up to the hundred-thousandth B.Th.U. mark before reaching the unit of one. How can a sufficiently lucid comparison between an electric radiator, rated in kilowatts with electricity at so much per unit, and a gas fire, rated in cubic feet with gas at so much per therm, be portrayed to the uninitiated? It can only be done by conversion back into B.Th.U. or expressed in terms of cost per hour, and even then, the uninitiated has very little understanding of the measure of heat he is to get for that money. Personally, I think there is a way to do it both simply and satisfactorily. My suggestion would be to create a new unit of 100 B.Th.U. to be known as a "Millitherm," or, as its name implies, the thousandth part of a therm. This could be indicated thus: M/thm.

A Board of Trade electrical unit would thus become 34·12 m/thms. A watt would become 0·034 m/thm., a figure not really as finicky as it seems, owing to the watt rating for a heating appliance usually running into hundreds and upwards. Likewise, a cubic foot of Nuneaton 200 C.V. gas = 2 m/thms.; a cubic foot of Halifax 400 C.V. gas = 4 m/thms.; a cubic foot of Manchester 459 C.V. gas = 4·59 m/thms.; a cubic foot of South Metropolitan 560 C.V. gas = 5·6 m/thms., and so on.

An electric radiator consuming 2½ kilowatts per hour at 1d. per unit (allowing 100 p.ct. efficiency) would have a thermal output of 2·5 multiplied by 34·12 = 85·3 m/thms. per hour, or at the rate of 34·12 m/thms. for a penny.

Working back from this figure the equivalent for a gas fire (assuming 75 p.ct. efficiency) at 9d. per therm, or 0·009d. per m/thm., would be as follows:

Thermal output	85·3 m/thms.
Add 33⅓ p.ct. for loss and ventilation . .	28·43 "
Thermal in-put required . . .	113·73 m/thms.

which would cost 1·023d. per hour, or an effective heating value at the rate of 83·38 m/thms. for 1d. On these figures it is easy to show the non-technical purchaser that the ratio of

values obtainable with gas at 9d. per therm, as compared with electricity at 1d. per unit, would be as 2·44 is to 1.

In the case of a given thermal requirement the quantity of gas in cubic feet would be arrived at exactly as is done in the case of the therm—viz., by dividing the total quantity of B.Th.U. required by the calorific value of the gas in B.Th.U.; but I suggest that even here it would be less confusing still to continue to work in m/thms., as, generally speaking, the decimal points could, without detriment, be neglected. In the case of the gas fire it will be noted that a 25 p.ct. loss in efficiency has been allowed for, but that beyond just mentioning the fact, no credit has been taken for the advantages of ventilation—a feature entirely absent from the electric radiator.

Owing to the lack of uniformity in calorific values of gas supplied in different districts, the question arises: Would manufacturers have any difficulty in rating their appliances in m/thms.? Personally, I do not think so, as the manufacturer, at the present time, has to vary the size of the required orifices to suit the gas of the district for which the appliances are required. In the case of gas fires, every gas salesman either knows, or should know, the consumption of gas, of their particular calorific value, per radiant, and when this has once been converted into m/thms. it becomes a constant, which it is only necessary to multiply by the number of radiants to arrive at the total consumption in m/thms. per hour. The average prospective purchaser is quite unable to assimilate comparative values expressed in differential terms, as between gas and electricity, but a comparison expressed in like terms could be appreciated.

I trust that the suggestion may be found to be sufficiently practicable to be worthy of serious consideration. No doubt, it will evoke its due share of criticism, and in order that it may be considered purely on its merits I enclose my card and sign myself,

ANONYMOUS PRO TEM.

Oct. 10, 1930.

Uniform Calorific Value.

SIR,—When seeking a subject for a paper in response to an invitation of the President of the Wales and Monmouthshire Institution of Gas Engineers, I obtained a lead from the frequent admonitions that are given to the smaller works—that they should put their house in order to meet imminent competition. It gave me the idea that, if the managers of the smaller undertakings could be tempted to vent before Press representatives the troubles they talk of in their absence, it would be to the general good. This naturally led to the fundamentals—the gasification of coal and the consumption of gas, and thence to the cognate points of "Declared Calorific Values and Pressures."

The representatives of small undertakings did not fall to the temptation, and those who took part in the discussion were emphatic that the day of the small gas-works is gone, and that re-organization should take the line of amalgamations and joint working.

As a preliminary to any such procedure, it would be expedient to consider the methods of manufacture and note the quality of gas supplied throughout the country; and to this end the interesting article of your contributor "B.Th.U." is useful.

It is doubtful whether—notwithstanding the research work of the Institution of Gas Engineers, the Fuel Research Board, Leeds University, and the London Companies—we shall ever arrive at agreement as to the best method of manufacture. A discussion on the time-honoured question of horizontal *v.* vertical retorts usually terminates with the plea that "circumstances are different"—the universal excuse of the "expert witness" when proving to-day what he disproved yesterday.

On the question of quality your contributor "B.Th.U." states "the fundamental fact that it is local facilities as to supply of coal, &c., which still determine what quality of gas an undertaking can most economically supply." I agree with him.

It was that fundamental fact that led me to express the opinion: "It is reasonable to expect some degree of uniformity between the supplies of neighbouring concerns," since their facilities as to coal supplies, &c., must be similar. The "quality of gas an undertaking can most economically supply" when using South Wales coal must differ from that of an undertaking using South Yorkshire coal, but this fact does not preclude an approach to uniformity of supply between works in any one industrial area.

Our industrial areas, speaking generally, are situated on or near a coalfield. They are densely populated, and it is in those districts where amalgamations are likely to take place. Each coalfield has bituminous coal, and gas undertakings in each area would not be working under widely different conditions as to coal supplies. Why, then, should they differ as to calorific value? Values in South Wales vary between 400 and 500 B.Th.U.

Again, "B.Th.U." states that "Revised declarations have been both upward and downward." This is surely an indication of a tendency to level-up. When those at the lower declarations come up, and those at the higher come down, we shall have attained uniformity.

I have no desire to discuss a "National" standard, but the figures given by your contributor are of more than passing interest. Omitting the seven extremists, he gives the declared values as from 400 to 560 B.Th.U. No fewer than 240 undertakings are declared at from 400 to 450 B.Th.U., and of the latter a good proportion may be assumed to be selling straight coal gas. The South Metropolitan Gas Company sell straight coal gas at a declared value of 560 B.Th.U., a difference of between 160 and 110 B.Th.U. It is plain that if the 240 engineers are right, Dr. Carpenter must be wrong. Someone ought really to tell him—and the B.B.C. should broadcast the interview.

Your contributor suggests that I did not plead enthusiastically on the subject of my paper, but I assure him that I am convinced that differences of from 50 to 100 B.Th.U. in the declared values of works in an industrial area are not conducive to progress in the industry.

Touching on the point of enthusiasm, I would commend the following to "B.Th.U." and others. Your readers will have noted that the Chairman of the Porthcawl Gas Committee told us that he was an electrical engineer, and that he had been *fighting* gas all his life. He had now retired, and hoped that the gas and electrical industries would, in future, work amicably together, as there was room for both. One frequently hears leaders of the gas industry propound those live-and-let-live sentiments. There will be little need for such opinions in the near future, and enthusiasm in the profession will best be demonstrated by a disposition to FIGHT all the way, and all the time. There may be room for both supplies, but enthusiasts should see to it that gas supply gets the drawing room—not the back attic.

"B.Th.U." writes of being "bound hand and foot," of "lashes," and of "legislative shackles." It would be well for the gas industry to face the fact that the need for the abundant advice that is being offered to the smaller undertakings is primarily due to "legislative shackles"—*golden shackles* with which the Government has adorned the electrical and oil industries.

The complaint of the smaller concerns is that they have to face competition with an electricity industry that is spending millions of pounds backed by the British Government; and an oil industry in which some millions of British funds are invested.

The brunt of the campaign falls on the administrators of small undertakings in industrial areas. They are doing as they are bid, but they need something more than cheery words if all of them are to pull through. One can be quite optimistic as to the future of gas supply. It is a key industry and a national asset, but a policy of drift as regards the smaller concerns can only aggravate the situation in the provinces, and make recovery slow.

J. MOGFORD.

2, *Derwen Road, Llanishen,*
Cardiff.
Oct. 11, 1930.

Uniform Street Lighting.

SIR,—At the recent conference of street-lighting engineers, a plea for the standardization of highway illumination was put forward, and the advantages of such standardization were generally agreed to. South London authorities are at present setting a notable example to other districts by their endeavours to establish a uniform system of lighting of the main roads leading from the metropolis to coastal towns. After a series of prolonged tests, lighting experts as well as prominent motorists who took part in them, were unanimously agreed that gas provided the most reliable and evenly diffused light at a minimum cost.

It is, therefore, difficult to see why a small area of just over a mile of Lewisham High Street and at Loampit Vale is so poorly lighted by an entirely different system of illumination from the remainder of the district.

The sharp contrast of the irregular glare emanating from the lights in this small area is especially trying to motorists who, entering or leaving London, have accustomed their eyesight to the softly diffused light of the centrally suspended high-pressure gas lamps.

The Lewisham Borough Council, which is responsible for the lighting of this neighbourhood, will earn the gratitude of every motorist passing through the district at night (as well as considerably enhance its appearance) if they will have the present experimental lights removed in favour of the centrally suspended system.

KAYE DON.

Rathmines,
Sunbury-on-Thames,
Oct. 8, 1930.

THE NEWS OF THE WEEK

Fifty Boys from Swinton (near Rotherham) National School were shown round Manvers Main Colliery coke oven plant on Oct. 1, the various stages to the point where crude gas is obtained being explained to them. On the following day the same party of boys visited the Swinton Gas-Works, where Mr. J. W. Brearley, Manager, explained the process of purification.

Colchester Stock Issue.—As will be seen from our advertisement columns, Messrs. A. & W. Richards, of 37, Walbrook, E.C. 4, are offering for sale by tender, on behalf of the Directors of the Colchester Gas Company, £10,000 6 p.ct. preference stock at a minimum price of issue of par. Tenders for this issue should be received not later than 11 a.m. on Tuesday, Oct. 21.

The Exhibition of Electrical, Optical, and Physical Apparatus (the twenty-first annual exhibition) is to be held by the Physical Society and the Optical Society on Jan. 6, 7, and 8, 1931, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, there will be a Trade Section and a Research and Experimental Section; and the Section for the work of apprentices and learners, introduced at the last exhibition, is to be continued.

Burts & Harvey was registered as a private company on Oct. 1, with a nominal capital of £150,000 (50,000 7 p.ct. cumulative preference and 100,000 ordinary), to acquire the tar department of the business carried on by Burt, Boulton, & Haywood at their Eling Works, at Totton, near Southampton, together with that portion of the business carried on by Mrs. M. E. Harvey and F. Kilpatrick, as T. H. Harvey, which is known as the Stampshaw Chemical Works, at Portsmouth.

An Increased Gas Supply for Montreal will be the result of extensions to be undertaken this year by Montreal Light, Heat, and Power Consolidated. The construction of a gasholder with a total capacity of 10 million c.ft. will be undertaken, the estimated cost of which will be $600,000. The complete programme of extensions planned by the Company will cost approximately $2,000,000, and about 300 men are now employed on excavation work connected with the laying of gas and electricity mains.

The Australian Gas Light Company show profits for the past year, including the balance brought forward, amounting to £345,866. The Directors now recommend the payment of a dividend for the past half-year at the rate of 4 p.ct. on the "A" and "B" shares, which will absorb £164,400, leaving a balance to be carried forward of £17,066. The profits of the year were insufficient to meet the dividend by the sum of £18,227. In addition to the above insufficiency, the stoppage on the Maitland Coal Fields caused the withdrawal of the sum of £181,647 from the Company's special purposes and depreciation fund, to meet the extra cost of coal purchased during the year. On Feb. 1, 1930, the Directors issued £750,000 "1936" debentures, and £750,000 "1940" debentures to replace the debentures which matured on Feb. 1, and also to meet additional capital outlay for plant, &c.

More than £40,000,000 a year is lost to the community through the pollution of the air by smoke. Attention was called to this remarkable fact by Mr. T. E. Birtwisle in a paper read before the Sanitary Inspectors' Association at their Annual Conference at Ilfracombe. Five times as much soot is discharged from domestic chimneys as is emitted by industrial chimneys, continued Mr. Birtwisle, the actual figures being 2½ million tons from the former and half a million from the latter. The Victorian sitting-room fire-grate constructed entirely of iron, inefficient and usually ugly, is still to be found in many houses, and the efficiency of the average coal-burning grate still leaves much to be desired. There is urgent need for breaking down the old prejudice against the use of coke for domestic purposes. Improved methods have resulted in the production of coke of high ignitability and a definitely lower sulphur content than the original coal. Recent years have seen the introduction of greatly improved appliances for burning this class of coke in houses. One of the most popular coke-burning open-type grates, states Mr. Birtwisle, is the "Metro," which is being manufactured and distributed on behalf of the South Metropolitan Gas Company. Since their introduction in the South London district in 1928, 7500 of these coke fires have been installed, and there is a steadily growing demand.

The Price of Gas at Newport has been reduced from 4s. 3d. to 4s. 1d. per 1000 c.ft., and in Johnstone by 1½d. per 1000 c.ft., making the price 2s. 6d. per 1000 c.ft.

A New Type of Gas Lamp, specially designed to illuminate policemen on point duty, is being installed at important traffic junctions in South London. These flood lights, which are fitted with skilfully constructed reflectors and hoods and are lighted by high-pressure gas lamps of 1000 candle-power, throw a flood of light on policemen directing traffic so that they can be seen clearly by approaching cars.

An Experiment in Street Lighting is being made in Birmingham—along the Hagley Road, Edgbaston. At the request of the Public Works Committee, the Gas and Electric Supply Departments of the Corporation are each lighting separate lengths of the roadway, under different methods. The object is to afford guidance to the Lighting Department as to the best methods of illumination under varying conditions.

An Electricity Failure caused considerable inconvenience on the morning of Oct. 2 to premises in Frankfort Lane, Plymouth. Both light and power were affected and the publication of a local paper was delayed, for, though the actual press was unaffected, all the linotypes, which are responsible for the setting of type, were unable to operate. Consequently, all the setting had to be done by hand in the old-fashioned way. At length another supply main was brought into operation, but until a late hour in the morning engineers were at work endeavouring to find the cause of the failure.

A Happy Re-union of pensioned servants of the Stanton Ironworks Company, Ltd., was held recently at the club house, when upwards of one hundred and forty sat down to a tea and concert organized by the Stanton Works Committee. The chair was taken by Mr. E. J. Fox, supported by Mr. Charles Crompton and other officials of the Company. A speech of welcome was given by Mr. S. Page, President of the Works Committee. An enjoyable feature of the evening was the reading by Mr. Fox of a letter written by Mr. Grebby, a pensioner whose age is ninety. The letter contained many interesting and amusing incidents that took place at Stanton Ironworks in its early days. He wished the pensioners the best of health in their remaining years.

A Dividend of 7 P.Ct. is recommended by the Directors of the Maryborough (Queensland) Gas and Coke Company, Ltd., for the half-year ended June 30 last. The period just ended, state the Directors in their report, is the first full term of six months the Company has had to bear the loss of the major portion of the hospital consumption. This, together with the effect of the continued trade depression, are the principal factors responsible for a considerable falling off of gas sales as compared with the corresponding period of 1929. Sales of residuals also show a decrease due to the fact that a large quantity of coke was sold in the June, 1929, period, which was held in stock previous to that time. Against the decreased revenue, a considerable saving was effected in the expenditure as compared with 1929. After writing off £300 for depreciation, the profits amount to £1207. To this amount has to be added the sum of £429 brought forward from last half-year, making the total amount at credit of profit and loss account £1636. After payment of the recommended dividend, there will be a balance to be carried forward of £193.

The Dismissal of Employees in the service of the Shipley Gas Department, consequent upon the installation of new plant, costing £26,000, came under discussion at a recent meeting of the Shipley Urban District Council. There were nine men for whom employment could not now be found, and instructions had been given for these men to receive notice. Mr. T. J. Gray, Chairman of the District Council and a Labour member, contended that no such notices should have been given to the men before the matter had been before the whole Council, and he moved that the minute be referred back to the Committee. Mr. W. H. Bannister, supporting Mr. Gray, said the Council should be the last body to add to local unemployment. Mr. A. W. Robson (Chairman of the Gas Committee) said that if the new £26,000 plant was not going to effect any saving in producing costs the Council might as well have retained the old plant and the whole of the old staff. He was not aware that the notices had yet been served on the men concerned. After discussion, Mr. Gray's amendment was defeated, and the Gas Committee minutes were approved.

THE NEWS—continued.

West Bromwich Jubilee.

The West Bromwich Gas Department celebrated their jubilee on Thursday last, when the members of the Town Council, officials, and a few privileged guests paid a visit to the gas-works at Albion, and were afterwards entertained at tea at the new showrooms.

During the tour of inspection of the works the visitors were able to see the efficiency of modern gas-making. The extent to which the works have developed during the past few years is very marked. In a souvenir brochure issued by the Gas Committee, it is recalled that West Bromwich originally formed part of the extensive district comprised in the area of gas supply covered by the Birmingham and Staffs. Gas Light Company. The Birmingham Corporation purchased the powers of this Company in 1875, but the West Bromwich Improvement Commissioners decided to exercise their rights under a clause in the Birmingham Corporation Bill; and the West Bromwich Improvement (Gas) Act of 1876 marked the definite beginning of the West Bromwich Gas Undertaking.

The cost of acquiring the right to erect works and supply gas amounted to £71,704, and the capital cost of providing the works was £78,999. The town was first served by gas from its own works on July 18, 1880.

There have been four managers prior to the appointment, in 1918, of the present Manager, Mr. J. W. Allin, and all of them are still living, two—Mr. T. Glover and Mr. H. E. Copp—having attained the office of President of the Institution of Gas Engineers.

The gas made at the works has increased from 125 million c.ft. in 1880 to 531 millions in the current year.

The Mayor (Councillor S. Crump) proposed the toast of "Success to the gas undertaking."

Alderman J. A. Kenrick said the last fifty years represented a record of splendid work on the part of the successive Gas Committees, and he congratulated the present Committee upon the way they had discharged their duties.

Alderman Cox, in responding to the toast, mentioned that the Committee would, in the near future, have to consider the question of the provision of increased storage capacity, and added that there were 16,500 consumers of gas for domestic and industrial purposes.

Fuel Research and Smoke Abatement.

In a paper before the National Smoke Abatement Society on Saturday, Sept. 27, Margaret Fishenden, D.Sc., F.Inst.P. (Fuel Research Division, Department of Scientific and Industrial Research), stated that in the interests of smoke abatement the possibilities of coke as a boiler fuel have been investigated by the United States Bureau of Mines, the Canadian Department of Mines, the Comité Central des Cokes de France, as well as by various commercial bodies, and it has been shown that under suitable conditions both gas coke and metallurgical coke give efficiencies at least equal to those obtainable from coal. It has to be remembered, however, that in boilers designed for use with coal the reduction in capacity entailed by the change-over to so bulky a fuel as coke may cause trouble. Although black smoke is not emitted, the thermal loss due to unburnt carbon monoxide may be very high for coke small enough to pass through (say) a 1-in. screen. In tests made by the Comité Central des Cokes de France, 45 mm. coke gave 83 p.ct. efficiency, in comparison with only 77 p.ct. for 20/35 mm. size, the reduction being due to increased formation of carbon monoxide. Similar results were obtained at the Stockholm Gas-Works, 65/100 mm. and 15/22 mm. coke giving in parallel tests efficiencies of 80 p.ct. and 62 p.ct. respectively, the loss in unburnt products of combustion rising from less than 3 p.ct. with the larger fuel to 21 p.ct. with the smaller fuel. Practically no difference was found between gas and metallurgical coke. Again, Aberle found efficiencies and carbon monoxide losses varying from 70 p.ct. to 80 p.ct. and *nil* for 60/80 mm. coke to only 50 p.ct. to 60 p.ct., and 10 p.ct. for 20/40 mm. coke. Kreisinger has suggested that when burning coke part of the hot surface of the fuel bed should always be kept uncovered in order to ignite any unburnt carbon monoxide.

Oil has many advantages over solid fuels for boiler purposes, since more rapid and finer regulation can be effected automatically, the handling of ashes and coal is eliminated, and fuel storage reduced to a minimum. It is, however, higher in running cost for continuous work, though its flexibility in use may often go a long way towards counterbalancing the higher fuel costs.

For domestic purposes the main alternative to raw coal are gas, coke, or other carbonized fuel, and electricity. The gas industry have striven systematically towards improved methods of manufacture, distribution and use, and in consequence the yield of gas per ton of coal carbonized has steadily increased, the price per therm has fallen, and the efficiency of gas appliances has improved.

In regard to low-temperature carbonization, externally heated retorts are most suitable for producing a solid smokeless fuel. These are relatively expensive to erect and work, and are scarcely likely to pay unless the coke can be sold at a sufficiently high price to cover the cost of the coal treated. Since only about 14 cwt. or 15 cwt. of coke is produced per ton of coal, this means that the price of the coke would have to be 30 or 40 p.ct. above that of the coal. The demand for low-temperature coke at a price equal to that of the best household coal still exceeds the supply, but comparatively little is yet available, and there is still doubt whether it could be produced economically on a scale at all commensurate with the present national requirements even at this price. Further, if any considerable proportion of the 40 million tons of raw coal now used for household purposes were to be replaced by the product of low-temperature carbonization, it might be expected that the price of coal suitable for treatment would rise, while the price of domestic coal would fall. From the many estimates that have been made it seems probable that the damage directly due to smoke from domestic fires averages at least 10s. per ton of coal burned, while if the coke from low-temperature carbonization could command 10s. a ton more than household coke, some of the processes already developed could probably be worked at a satisfactory profit.

The substitution of gas coke for coal should be encouraged, concluded Dr. Fishenden. Except for the difficulty of ignition, good quality gas coke is an excellent domestic fuel for most purposes; it burns well in suitably designed open grates and in kitcheners, usually heating the water better, and the oven less well, than coal.

Examination Successes at Westminster Technical Institute.

The Principal and Staff of the Gas Department of the Westminster Technical Institute, Vincent Square, S.W. 1, are to be congratulated on the outstanding successes which were achieved by their students in all the public examinations this year.

In the Institution of Gas Engineers Higher Grade Gas Supply Examination, the following results were obtained: Ten out of eighteen candidates were awarded First Class Certificates, and, of these, Messrs. N. G. Scott and R. J. Willsmer obtained Distinctions.

In the Institution of Gas Engineers Ordinary Grade Examination in Gas Supply, out of 35 candidates who went in for the examination 22 obtained First Class passes, including three with Distinction. They were Messrs. Brunton, A. F. Mayo, and T. W. S. Sheldrake.

In the City and Guilds of London Institute Examination in Gas Supply Practice (Institution of Gas Engineers Minor Course) Mr. N. E. Denman obtained the First Prize (Silver Medal and an award of £5 5s.), while Mr. W. J. Kibble obtained the Second Prize (Silver Medal and the Society's award of £2 2s.). Mr. J. H. C. Bates also qualified for the Silver Medal.

New Main Fire Catalogues.

The new season's gas fire catalogues of R. & A. Main, Ltd., of London and Falkirk, are, as in recent years, published in two editions, large and abridged. Both are attractive productions, profusely illustrated and in keeping with the high standard of literature associated with the name of the firm. The variety of designs shown in their pages, and the numerous finishes offer a most comprehensive choice of fires. Notable additions to the firm's manufactures are embodied this season in the "Unimain" radiator and the "Romain" panel gas heater.

The "Unimain" is entirely new in design, with unique facilities for dismantling and cleaning. This steamless radiator has a generous cross-sectioned tube area to ensure perfect combustion, and a greater air intake which obviates condensation troubles. Its "Unistat" automatic heat control has a generous margin for individual requirements and a liberal allowance for exceptional conditions.

The "Romain" panel gas heater has been specially designed for garages, halls, offices, &c., and as it fixes on the wall instead of on the floor it causes no curtailment of floor space and no obstruction.

The Lodge-Cottrell De-Tarrer.

Messrs. Lodge-Cottrell, Ltd., of Birmingham, have published a booklet dealing with the elimination of tar from gas. The following is an extract from the booklet: The Lodge-Cottrell electrical precipitator has been adapted to the special requirements of de-tarring all kinds of combustible gases. It has the outstanding advantages of achieving the complete removal of tar, without creating back pressure. It therefore seems to provide the real and final solution of this difficult and annoy-

ing problem. Briefly, the precipitator consists of a series of vertical pipes, through which the gases are led; in the centre of each pipe is an electrode charged to a high potential. The ionization which results causes every globule of tar, however minute, to become charged and thus to be forced away from the electrode to the pipe wall. The liquid slowly trickles down to the tar well, from which it can be run off as desired. The power consumption is extremely low, the maintenance negligible, no special skilled attention is needed; yet the tar is removed from the system completely before it has had an opportunity of clogging mains and valves or causing harm to any of the gas-works plant.

The De-Tarrer is placed immediately after the retorts, and removes the heavy tar fog completely as the first purifying operation. The system makes it possible to obtain a fractional separation of tar liquid and light oils, the latter being recovered without trouble at a further point in the system in a second precipitator.

Apart from the ease of this method of separation, the fact that it occurs at an early stage has the great benefit of improving the character of the effluent liquid. With the Lodge-Cottrell De-Tarrer the tar acids are almost entirely precipitated with the heavy tars; thus the tar acid content of the liquor falls so greatly that the effluent becomes an innocuous and almost colourless liquid.

The following advantages are put forward:

1. Tar removal is complete. Extended tests have shown that the recovery efficiency is maintained indefinitely at over 99 p.ct.
2. The tar is removed at the earliest possible point before it has time to do any harm.
3. The equipment is exceedingly compact.
4. Back pressure created is negligible, being less than ½ in. water gauge.
5. First cost is reasonable, especially bearing in mind the extraordinarily low operating, maintenance, and depreciation charges, only ordinary attention being required, and power costs being extremely low.

GAS SERVICE - - -

Discussed from the viewpoint of the Gas Salesman.

Illustrate Your Showrooms in the Press.

Addressing the Southern District (London Area) Circle, this year's Chairman, Mr. W. H. Becket, of the Gas Light and Coke Company, said: "The value of Press publicity and advertising for increasing sales has been so clearly demonstrated that we cannot fail to place it in a very prominent position in our sales campaigns. The preparation of material is so much a specialized effort that this work should certainly be left to professionals, and we could not do better than place it in the capable hands of the B.C.G.A., and confine our attention to furnishing them with particulars of our programme, so that they can anticipate our needs and link up with our own special efforts at the right season. I will make only one suggestion. Gas showrooms provide one of the best fields for selling, and I think that more could be done to popularize them by constantly illustrating an exterior or interior view in the local Press. Each insertion should convey an invitation to visit the district showroom for ideas in domestic economy and gas utility, clearly worded to inform them that they will not be pressed to buy, but that we should be happy to give any information or suggestions."

Shop and Display Lighting Campaign.

To our readers the initials B.C.G.A. have been long familiar, but to some the letters E.D.A.-E.L.M.A., when used to describe a shop and display lighting campaign, may be less clear. They refer, of course, to electrical Associations who are pushing the campaign referred to. The reasons in favour of improved shop and display lighting were so convincingly put by Alderman E. Huntsman (President of the Electrical Development Association) on a recent occasion, that we may be pardoned the reproduction here of some of them. He said that up-to-date illumination helps the salesman to sell for three powerful reasons. First, the sheer beauty and glareless brilliance of modern window lighting systems attract around the display windows of a store an interested public. That public is the retailer's potential customer. Secondly, because of the scientific manner in which that light is directed upon the merchandise, the whole beauty, worth, and purpose of it is revealed. Were the standard of illuminating art which is being urged adopted throughout the country, brightly lighted shops would cheer the meanest streets. Seen through the windows of those well lighted shops, there could be no doubt about the colour or form of the goods, the quality of their workmanship, of the requirement they were designed to fill. Then there is a third reason—a reason deep seated in human psychology—that light has an enormous effect upon the mind. It is a great healer and tonic to the brain depressed with worries and responsibilities. Better and more beautiful illumination of cities, and the shops and buildings within them, puts cheerfulness, courage, and new vigour into the minds of men.

What a Census Revealed.

Alderman Huntsman went on to point out that, in spite of remarkable improvements in store and display lighting during the last ten years, the figures obtained from a survey specially made revealed a lamentable poverty of light. Only 25 per cent. of the shops in this country have effective interior lighting; but the figures for window lighting revealed a still worse condition of affairs. Out of approximately 500,000 shop windows in Great Britain, 450,000 are lighted either by naked electric lamps, out-of-date fittings, or by such an ill-disposed arrangement that what little light is used is mostly wasted. No attraction is created, causing passers-by to stop. The quality of the light does not assist sales, because neither the workmanship of the displayed goods nor their purpose is distinguishable. Although everyone will admit the attractions and real beauty of these devices, less than 5000 shops and stores in the whole of the country are using illuminated facias and flood-lighted fronts.

The census showed that first, so far as good lighting is concerned, come some 45,000 boot and shoe retailers. Two-thirds of these shops have reasonably good lighting. Following in the order of their intelligent use of light to promote sales, and customer-comfort, come tailors, drapers, and outfitters. Among the worst users of light are butchers and provision merchants. "But," asked the President, "what is it about the mental make-up of 36,000 British tobacconists to account for less than 1000 using really up-to-date lighting? For of all retailers, there is a case for using better lighting here, since most tobacconists trade for longer hours."

Finally, Alderman Huntsman expressed the hope that he might be able to open his favourite daily paper one morning soon and read that England had become a land of Brighter Cities—a land where even the village shop had emerged from the single oil lamp period, and the smallest streets in country towns were flooded with the cheering light of windows generously illuminated.

Mention is made here of what the President of the E.D.A. had to say, because his address contains suggestions for the gas salesman, as well as for the electrician.

The Method of Procedure.

For the purpose of this campaign in favour of electricity, during September and October 600,000 letters and booklets will have been mailed to British shopkeepers. There have already been conferences in various important cities throughout the country. Following these there will be shop and display lighting demonstrations of a practical kind, which will be attended by shopkeepers. Branch development centres of the industry in conjunction with local Chambers of Trade have arranged for lectures to be given, with the aid of lantern slides and demonstration equipment, including a full size portable window. Co-operation is also being obtained from the National Drapery Association; while Sales Managers' Associations, Chambers of Trade and Commerce, Rotary Clubs, and sign-making interests are also helping.

Good Advice.

At a meeting of the Northern Area Salesmen's Circle, Mr. J. R. Hepple, of Newcastle-on-Tyne, mentioned that early last month an announcement appeared in the Technical Press that the E.D.A. was about to start this shop lighting campaign. Salesmen, he said, will be well advised to make a special note of this, and look round the district to see what condition the shop lighting is in. "They will," he suggested, "undoubtedly find a number of instances where it can be greatly improved. A burner with three No. 2 size mantles fitted with an opal globe will provide a well diffused light of about 300 c.p., and make an excellent shop light. Wherever a doubt exists in the mind of a consumer as to whether this type will meet his requirements, offer to fit one on approval. Be first in the field in suggesting improvements. Even if a shopkeeper is dissatisfied with electric lighting after having it installed, it is a difficult matter to persuade him to spend money twice."

ART AND ITS RELATION TO INDUSTRY

Mr. Saml. B. Chandler, M.Inst. Gas E., A.M.I.Mech.E., points to the desirability of encouraging artistic vision.

Industrial processes, with their concomitants of moving machinery, noise, dust, flame, steam, and smoke, are generally regarded by both worker and observer as merely the means to an end, and the idea of beauty or art is quite alien, and, indeed, considered to be out of place in such surroundings.

It may be asked, Who can see beauty in (say) a gas-works? The various buildings and steel structures, furnaces, machinery, and tar begrimed plant which transform solid fuel into gaseous energy are, naturally, to an engineer or an interested observer, of practical or academic interest; but it may reasonably be questioned whether, when one views a works where industrial processes are undertaken, one fully appreciates the transformations which are taking place, or can see in them some subtle beauty of form, colour, or dynamic expression.

Man's interest in his work is usually measurable in terms of financial and practical benefit. How much more interesting would work become were he able to appreciate in his everyday surroundings some form of beauty, be it harmony of motion, sound, or form, which he cannot now perceive. How much better it would be were he freed from the purely material aspect of life. The interest and enthusiasm aroused by his new vision would help him immeasurably in performing the routine matters of business, and would foster originality and individuality of expression.

We often hear it said, "There is no sentiment in business!" This may be true where buying, selling, or "jobbing" is concerned, but it does not apply to undertakings which call for constructive force and united mental effort. From the broad scheme, through the various stages of design to the smallest details, the processes of construction call for co-operation of brain forces harmonized to the tune of the "end in view."

That there really is art in industry has in some measure been shown by the work of thoughtful and far-seeing artists who have recorded impressions of beauty such as an artist can perceive. These artists have a wonderful conception of the atmosphere surrounding the work they happen to be depicting; they transform what appears to be a most uninteresting shop or works into a picture portraying what lies beyond the work of man.

Surroundings play an important part in a man's work, and they should be planned to better the conditions of both skilled and manual worker. Of course, many welfare schemes are in operation, which include canteens, sick and other clubs, sports grounds, and holiday advantages. These are excellent as far as they go, but lack of knowledge of the finer elements of the mind is likely to result in the benefits being misunderstood, and their meaning misconstrued. Great care should be exercised in, and consideration given to, such matters as lighting, both natural and artificial, in our workshops and offices. Colour of ceilings and walls, and the disposition of machinery and plant, play a great part in reducing irritating conditions to a minimum, and create a sense of bodily and mental composure. Restrained colour schemes and adequate lighting prevent eyestrain and lead to comfortable conditions of work. These factors are of the utmost importance in creating happiness; they produce more satisfied workmen, who are able to do their day's work without undue fatigue.

Employers have for some years interested themselves very largely in the welfare and comfort of the worker, the academic view having been replaced by the practical; this interest is greatly appreciated. If, by pictorial presentation of the surroundings in which workmen earn their daily bread, they may be brought to appreciate properly the value of environment, and the relation it bears to constructive work, when seen from the wider viewpoint, then nothing but good must result.

GLOVER-WEST VERTICALS AT MARYPORT

Official Opening Ceremony of New Plant.

"The quality of the gas which we are now receiving speaks for itself, and within a few weeks of the installation of West's Gas Improvement Company's vertical retorts we were able to reduce the price by 5d. per 1000 c.ft., which, of course, was entirely owing to the new plant. The price is now as in pre-war times—3s. 4d. per 1000 c.ft.—and another great feature of the new plant is that there is ample capacity, should it be required, for meeting an increased consumption."

These remarks were made by Mr. H. STOKOE, of Maryport, in Cumberland, at a luncheon which followed the inauguration, on Oct. 9, of the reconstructed and modernized gas-works, including an installation of vertical retorts, boilers, exhausters, works mains and connections, &c., all of which work was entrusted to Messrs. West's Gas Improvement Company, Ltd. In the chair was Mr. H. J. C. Walter, J.P., the present Chairman of the Maryport Urban District Council, and supporting him were Alderman F. J. West, C.B.E., Chairman and Managing Director of Messrs. West's Gas Improvement Company, Major W. Irwin, Managing Director of the West Cumberland By-Product Company, Mr. J. E. Blundell, M.Inst.C.E., Engineer and Manager of the Carlisle Gas-Works and Chairman of the Cumberland and Westmorland Gas Managers' Association, members and officials of the Maryport Urban District Council, and gas engineers from all parts of Cumberland and Westmorland.

The principal toast, that of "The Town and Trade of Maryport," was submitted by Alderman WEST. He said: "In submitting to you the toast of 'The Town and Trade of Maryport,' there are a great variety of aspects from which the subject might be approached, though necessarily a comparative stranger to your town can only approach the matter in a general way.

"The town is represented here by members of your Council and by representative townsmen. Your trade is represented by those of you who are engaged in commerce and industry. Addressing myself, therefore, to the councillors, business men, and manufacturers of Maryport, I submit that it is absolutely essential that your municipal activities should follow a line of development which, while keeping pace with the requirements of your civic and business life, refrains from imposing unnecessary burdens upon your ratepayers—burdens which, if excessive, will certainly militate against that recovery in prosperity which we all so ardently desire.

"In these times of unparalleled depression in trade and industry, it is fatally easy to take the line of obstructing and deprecating all public expenditure whatsoever. But, difficult as it may be, especially in prevailing circumstances, it is really more than ever necessary to distinguish between fruitful and unfruitful expenditure. I do not remember any period during my long connection with municipal affairs in Manchester—a connection which has now lasted more than 25 years—when more careful consideration has had to be given in regard to the activities and developments of our municipal work. There is to-day a greater need than ever of an increased interest in public business, particularly on the part of those engaged in commerce and industry. It should be evident to every business man that it is well worth while to spend a fair proportion of his time, valuable as it no doubt is, in the consideration of the affairs of the community in which his business is carried on, if only because these affairs have a very material effect upon the success of his own undertakings.

"It is exceedingly disappointing, I know, to those who come forward to assume the responsibility of the conduct of municipal government to note the apparent lack of interest displayed by citizens generally in the affairs of their town, particularly as this interest is measured by the proportion of those who take the trouble to go to the poll in municipal elections. It is somewhat cynically said (and, no doubt, there is a large degree of truth in the saying) that a town or other community gets the government it deserves. Lack of interest on the part of the citizens often leads to slackness and indifference arising mainly out of the want of encouragement felt by those responsible for carrying out the duties and activities of the community.

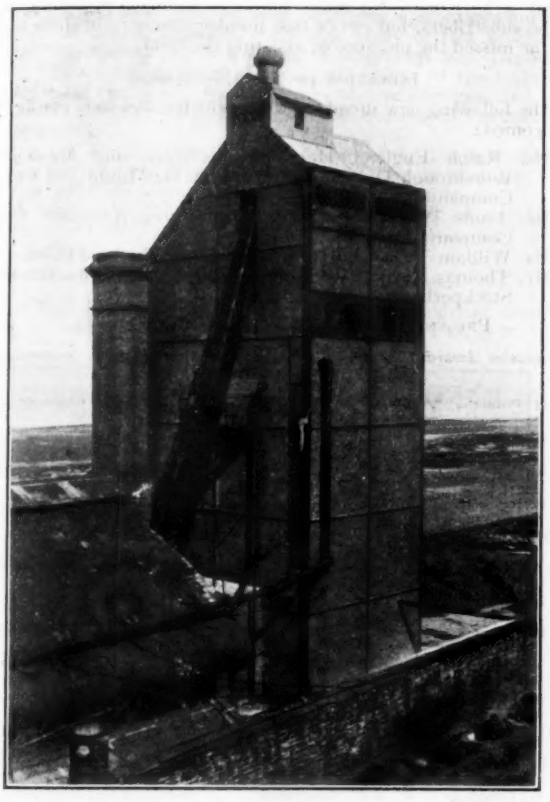
"The inauguration of the new gas-works to-day represents a development in civic activities which are closely associated with the development of your trade and business and the domestic life of the citizens, and I submit without fear of contradiction that the excellent example which you have shown might be termed fruitful expenditure.

It is fruitful expenditure in the sense that it will not impose any additional burden on those engaged in trade and commerce, but which, under the able management of your Engineer, will pay dividends which will be reflected in the cost of public services, and which, indeed, have already been reflected in the price of the gas. From the point of view of fruitful expenditure, therefore, most of us can claim that you have been well guided and spent wisely.

"The average person to-day is inclined to think that gas has had its day, and the fact that he thinks in that direction is a penalty of its very success. Probably this thought is due to the fact that the industry is over a hundred years old, and most people think it is so old that it is likely to be superseded by its rival—electricity. Yet I think it will surprise many people to know that in those countries where electricity is far cheaper than in this country, and far more lavishly used—taking the United States and Canada as the examples—gas is forging ahead steadily, in some places very rapidly, and the consumption in some of the large cities in America is greater per head of the population than in several of the large cities in this country, where gas has been developed over one hundred years.

"The ardours of the advocates of electricity sometimes blind not only themselves, but their clients, to the fact that there is no serious rival to gas for all purposes of heating and cooking in the homes of the people. And the extent to which most of the great industries depend for their success upon a supply of cheap gas is not fully realized.

"The recently issued Annual Returns of the Board of Trade reveal the truly astonishing fact that even in this year of depression and unemployment an increase in gas sales of 3·6 p.ct. is recorded—an increase which represents over 10 thousand million c.ft., or more



The Glover-West Vertical Retort-House at Maryport.

than the annual consumption of the City of Glasgow. This gas is sold to over 9 million consumers in Great Britain alone. You may, therefore, be quite sure that your money has been invested in no dying industry, but in an industry which holds the key to the solution of all the problems of the scientific utilization of our coal, and which is destined to increase in importance and in economical achievement until all the major requirements of cooking and heating, both in domestic and in industrial and manufacturing circles, are filled by the gas and coke derived from the treatment of coal in our gas-works.

"This, then, is truly fruitful expenditure, and in submitting to you this toast of the town and trade of Maryport I trust that the time is not far distant when the unfruitful expendiure of money upon mere relief will be a thing of the past, and that you, and all of us, will, in the near future, be restored to a reasonable prosperity, the well-earned fruit of your industry and assiduous attention to private and public business."

Coupled with the toast was the name of the CHAIRMAN, who revealed the very interesting fact that Maryport had its beginning on the very spot where they were gathered. The Golden Lion Inn was the first building to be erected in 1718, and past the doors ran the post horses on the road from Carlisle to Whitehaven.

After delving further into the ancient history of the town and the people in it, who "simply refuse" to be depressed by its black industrial outlook, Mr. Walter said:

"To me this is a very distinctive 'Red Letter Day,' because I have the feeling of the true British man who likes to stand fair and square with the world; we have given to the town in gas and gas production the very best the world can produce, and we can face the townspeople of Maryport and say, 'You are getting gas as good and as cheap as anywhere else.' I am not one of those who go about crying about electricity. It has its useful place, of course, but it will not hurt the gas industry—particularly, if everywhere people can get the same quality as we, thanks to the new plant, are producing now. It is excellent."

"The Gas Industry" was given by Major IRWIN. He opened:

"We all of us have it very well in our minds that West's Gas Improvement Company, Ltd., have given us an extremely good job, and it has been a very great pleasure to work with their officials. Their representatives have done everything possible to meet the wishes of our Engineer, Mr. Bowness; and an expression of our appreciation is the very least we can do. To Mr. Bowness this is truly a 'Red Letter' day in his life. For some time prior to the advent of our wonderful new installation, he often looked worried; but to-day he should feel that his worries are over, and rejoice."

After reviewing the course of action which led up to the Council's latest enterprise, Major Irwin said: "When I first came to Maryport I went to the Town Hall to order a gas cooker for my wife. The man looked hard at me, and then said, 'We cannot be bothered with that sort of thing,' and so I had to go to Workington. That could not happen nowadays. Since then, although our population has remained stationary and trade depression has deepened, our consumption of gas in Maryport has increased by 40 p.ct.—in ten years—and I am quite certain that we shall never regret having taken the step we are to-day celebrating. The ratepayers are now in possession of a works of a thoroughly modern and efficient nature, and which are a real pleasure to look at. It is a real asset to the town, obtained at a very reasonable outlay, and the mortgage debt on the works is a mere trifle in relation to the make."

Replying, Mr. BLUNDELL said:

"Responding to the toast of the health of the gas industry, I feel I am responding to the toast of the health of a very old and good friend of the people, and particularly the working people, of this country.

"The mere facts that the gas industry employs 180 millions of capital and 100,000 men, and that it pays 2½ million pounds per annum in rates, are a sufficient measure of its magnitude. The gas industry, as it were, takes charge of some 18 million tons of coal per annum, and instead of leaving it for the domestic consumer to burn inefficiently in the kitchen fire with all the consequent smoke and dirt and grime, it presents the housewife with a clean, convenient fuel which she can turn on and off at a moment's notice without trouble or fatigue. Gas begins to be a willing and efficient servant very early in the morning. In the old days the man setting out from home in the early morning generally went without any warm food or drink. To-day the gas cooker enables him to start out on a hot breakfast. It has been pointed out that 'even a man can cook by gas;' and many a man, thanks to gas, nowadays refrains from disturbing his wife early in the morning because he has merely to turn the gas tap.

"Gas is a good friend too in the middle of the morning because the housewife now finds herself in a position to do the cooking—with the modern regulated cooker she can even put the whole dinner in the oven and go about her usual household duties—without laying up a legacy of sooty pots and pans to be cleaned afterwards. Washing day no longer entails the trouble of lighting the copper fire, and drying indoors on rainy days can be readily catered for.

"Gas remains the trusty friend when visitors come, and a fire is wanted in the best room without the trouble of laying it and waiting for it to burn up. And gas is the ever-ready friend of the sick, the weak, and the aged, with its pleasant warmth in the bedroom always available in the hour of need. If, therefore, we admit that gas is our very good, our old and tried, friend, it is necessary that we see to it that it gets fair play, particularly from our rulers and governors.

"There is a very real danger that our politicians are being led away by the glamour of the 'new thing.' Electricity is no doubt an excellent servant too. I would not say for one moment that there are not fields of service which are adequately filled, and should be filled, by electricity. In most large gas-works, and many smaller ones, electricity is freely used for the transmission of power. But we should not let our newspaper editors, for instance, tell us so much about the romance of electricity that we forget that the gas-works is quite wonderful too, and capable of performing all the duties of lighting, heating, and cooking at about one-quarter the cost. What is more wonderful than the transformation of this coal—these fossilized remains of primeval forests—first into gas and coke representing 75 p.ct. of the total heat energy of the coal, instead of 30 p.ct. recovered in the electric generating station, and, after that, into all the valuable bye-products of tar and ammonia which form the basis of our great chemical industries and provide fertilizers for our broad acres?

"What is the sense, then, in throwing into unemployment the hundred thousand workers engaged in the gas industry, not to mention the many thousands employed in the allied trades providing gas appliances, merely that the same services may be rendered with much less efficiency by this new electricity?

"All we ask is that it shall be left to the consumer to decide whether he will use gas or electricity for any particular purpose without the interference of the politician. Neither the electrician nor the gas engineer can claim to have the means of fulfilling all the requirements of home or industry. There is room for both. In Carlisle from April 1, 1925, to March 31, 1930, we fixed 5442 gas cookers, 3361 gas fires, 2545 wash-boilers, and 860 other pieces, making a total of 12,217. No electricity department in any town of similar size can come anywhere near this figure."

Mr. BOWNESS said he knew he had an excellent plant, for the results so far had been most excellent. His associations with the staff of West's Gas Improvement Company had been most cordial. "As your gas engineer," Mr. Bowness concluded, "I can assure you that we have a thoroughly fine job."

THE "JOURNAL" TECHNICAL RECORD

Which also contains Full Reports of Meetings of Gas and Allied Associations ——

Manchester District Institution of Gas Engineers

UTILIZATION OF COKE BREEZE BY THE TREFOIS PRODUCER

By ALFRED L. HOLTON, M.Inst.Gas E. (Chief Engineer, Manchester Corporation Gas Department), and H. C. APPLEBEE, A.I.C., F.C.S. (Chief Chemist, Manchester Corporation Gas Department).

A General Meeting of the Manchester District Institution of Gas Engineers was held in the Board Room of the Manchester Corporation Gas-Works, at Partington, on Friday, Oct. 10, when 175 members and friends of the Institution attended, together with a large number of members of the Manchester Corporation Gas Committee and officials interested in gas production. Mr. W. J. SMITH, B.Sc. (Bolton), presided.

Among the Manchester Corporation representatives were Alderman John Harrison, J.P., Alderman T. Cook, L.R.I.B.A., Alderman Sir William Kay, J.P., Alderman G. K. Ashton, Alderman J. Bowes, J.P., Mr. J. H. Sillitoe, A.C.I.S. (Secretary of the Manchester Corporation Gas Department), and Mr. J. H. Cadman (Assistant Secretary of the Manchester Corporation Gas Department).

The PRESIDENT, on behalf of the Institution, extended a hearty welcome to the members of the Manchester Corporation.

The minutes of the previous ordinary general meeting of the Institution were unanimously taken as read.

LOSSES THROUGH DEATH.

The PRESIDENT referred to the recent passing on of Prof. Harold Bailey Dixon, who for many years had been connected with the Manchester University, and who was an Hon. Member of the Institution, and of Mr. George Haynes, of Liverpool. Prof. Dixon, said the President, had rendered valuable service to the gas industry by reason of the research work he had undertaken in connection with the causes of explosions; and the results he had achieved were of high technical importance and were applicable industrially. The members would be pleased to learn that the Secretary, with his customary care and foresight, had already sent a letter of condolence to Mrs. Dixon; and the reply was of such a nature that he would ask Mr. Bridge to read it *in extenso*.

The SECRETARY then read the reply of Mrs. Dixon to the letter of condolence as follows:

> DEAR SIR,—I have to thank you for the kind expression of sympathy you sent me from the President and members of the Manchester and District Institution of Gas Engineers, and also for the very beautiful wreath of lilies and chrysanthemums they so kindly sent.
>
> I know that my husband valued the honorary membership given him by your Institution. Such messages from his one-time students, colleagues, and friends have been a great comfort to me.
>
> I am,
> Yours very sincerely,
> MURIEL DIXON.

THE BENEVOLENT FUND.

The PRESIDENT announced that he had received a letter from Mr. Bennett expressing the hope that it would be possible to give greater support to the Benevolent Fund of the Institution. At present the subscriptions were not equal to the expenses. The suggestion was put forward in the letter that a Lancashire member and a Yorkshire member might undertake to see that no one in the respective counties they represented forgot to pay their subscriptions.

The SECRETARY said that as far as he was concerned he would be only too pleased to give of the best of his services in this direction. He did not anticipate that the extra duty involved would be very difficult to carry out, because there was no doubt that the majority of non-subscribing members would readily respond to the suggestion in Mr. Bennett's letter and become regular subscribers to the fund. If, however, the appeal should happen to fall upon barren ground, then he would venture to come along himself, with whatever fructifying influence he might possess, and endeavour to persuade every member of the Manchester District Institution to join the happy band of subscribers to the fund. At the moment, the position was a somewhat serious one. No fewer than 153 members were eligible to be subscribers, but out of that number about 70 of them had so far missed the pleasure of assisting the fund.

INDUCTION OF NEW MEMBERS.

The following new members were inducted and were cordially welcomed:

Mr. Ralph England Harrison, Secretary and Manager, Worsbrough Dale and Worsbrough Gas Light and Coke Company.
Mr. Louis William Harrison, Engineering Assistant, Gas Company, Barnsley.
Mr. William Trevor Jones, Manager, Gas-Works, Fleetwood.
Mr. Thomas Reynolds, Engineer and Manager, Gas-Works, Stockport.

PRESENTATION OF EXAMINATION CERTIFICATES.

Certificates Awarded by the Institution of Gas Engineers in co-operation with the Board of Education.

A. H. Pinder	Blackburn	1st Class Gas Engineering, Higher Grade.
H. Shackleton	Burnley	2nd Class Gas Engineering, Higher Grade.
G. A. Ward	Huddersfield	2nd Class Gas Engineering, Higher Grade.
F. Bell	Leeds	2nd Class Gas Engineering, Higher Grade.
J. M. Gibson	Manchester	2nd Class Gas Engineering, Higher Grade.
W. M. Gledhill	,,	2nd Class Gas Engineering, Higher Grade.
K. M. McGregor	,,	2nd Class Gas Engineering, Higher Grade.
F. W. Grounds	,,	2nd Class Gas Engineering, Higher Grade.
D. McCallum Thompson	,,	2nd Class Gas Engineering, Higher Grade.
G. H. F. Windiate	,,	2nd Class Gas Engineering, Higher Grade.
G. Gilden	Salford	2nd Class Gas Engineering, Higher Grade.
P. Sumner	,,	2nd Class Gas Engineering, Higher Grade.
R. W. Foulds	Liverpool	2nd Class Gas Engineering, Higher Grade.
W. Oldham	,,	2nd Class Gas Engineering, Higher Grade.

Certificates Awarded by the Institution of Gas Engineers to External Students.

W. Fairbank	Morecambe	1st Class Gas Engineering, Higher Grade.
K. E. B. Brown	,,	1st Class Gas Supply, Higher Grade.
F. N. Booth	Rochdale	2nd Class Gas Engineering, Higher Grade.
J. S. Marshall	Preston	2nd Class Gas Engineering, Higher Grade.
H. D. Sullivan	Lancaster	1st Class Gas Supply, Higher Grade.

In presenting the Certificates to the successful candidates, the PRESIDENT said that, as a representative of the Institution on the Board of Examiners, perhaps the best advice he could give the students who were preparing to go forward to the Higher Grade was that they should give considerable attention to ancillary subjects, and more particularly so when they were applied to the everyday operations in a gas-works. It was noticeable, during the course of the ordinary examinations for external students, which took place during the current year for the first time that there were too many students who did not know the ordinary laws governing even the correction of temperature and pressure of gas. Another point to be mentioned

was that in the case of students who were going forward for the Diploma the tendency had been for the engineering side to show considerable weakness. There had been difficulty in obtaining replies to even most elementary questions upon the theory of structures. There was no doubt that the difficulty of obtaining the Diploma would be greater in the future.

ELECTION OF OFFICERS.

The scrutineers reported the following elections:

President.—Mr. W. M. Carr (Stretford).

Vice-Presidents.—Mr. C. W. Ward, Assoc.M.Inst.C.E. (Wakefield); Mr. G. Dixon, B.Eng., Assoc.M.Inst.C.E. (Lancaster).

Hon. Secretary and Treasurer.—Mr. J. Bridge (Elland).

Committee.—Messrs. J. H. Clegg (Burnley), A. L. Holton (Manchester), and H. R. S. Williams (Altrincham).

Auditors.—Mr. William Hill (Stalybridge) and Mr. Francis Elliott (Leyland).

THE UTILIZATION OF COKE BREEZE BY THE TREFOIS PRODUCER.

By ALFRED L. HOLTON, M.Inst.Gas E. (Chief Engineer, Manchester Corporation Gas Department) and H. C. APPLEBEE, A.I.C., F.C.S. (Chief Chemist, Manchester Corporation Gas Department).

In many gas-works the problem of finding a profitable outlet for coke breeze is a serious one. The study of this problem led, in the case of the Manchester Corporation Gas Department, to the consideration of the practicability of the utilization of coke breeze for the production of producer gas, and to the use of the gas so produced for the heating of horizontal retort settings.

After a visit of inspection to the Continent, it was decided to install at the Bradford Road Works a Trefois producer, of the type which had been seen at Moll, in Belgium.

The object of this paper is to describe, as briefly as possible, the results of the experiment both with the producer itself and with the heating of the retort settings.

DESCRIPTION OF THE TREFOIS PRODUCER.

The Trefois producer (fig. 1) consists of a cylindrical vessel, 21 ft. in height from ground to top cover, and 11 ft. 9 in. internal diameter. It is made of mild steel, with a revolving grate, the lower part of the producer being water sealed.

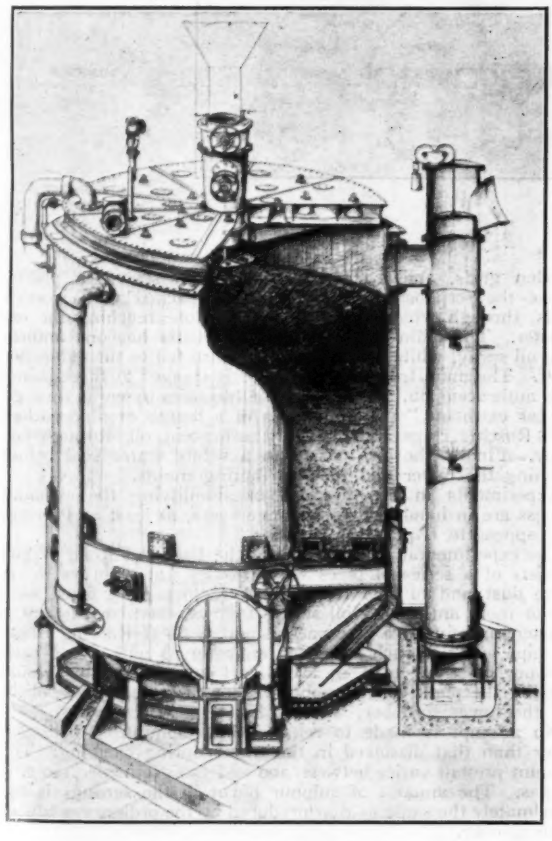


FIG. 1.

The body of the producer is water-jacketted by a casing 4½ in. wide, which extends from the top of the producer to the grate level 13 ft. below, thus avoiding the necessity for the refractory lining, which is a constant source of trouble with many types of producers. At the same time, the water jacket, which also extends over the top of the producer, serves for the generation of low-pressure steam. The air supply to the producer is made to circulate between baffles inside the top of the producer casing over the water, thus becoming saturated with water vapour, while the temperature of the air blast is raised correspondingly.

The fuel is fed into the producer through a specially designed distributor. The breeze passes from the overhead hopper through a regulating valve on to a distribution plate having four deflecting vanes, which direct the stream of fuel to the sides of the distribution chamber, this chamber tapering downwards. The breeze drops on to two rotating discs, the upper disc being the larger and each disc having an opening in the centre. Part of the stream of breeze passes through the hole in the upper disc, while part is caught by the disc and thrown off (by centrifugal force) to the sides of the producer. Of the breeze which reaches the second disc, part again passes through the hole and falls to the centre of the producer, while that which falls on the disc is projected to a position between the centre and the sides. In this way, even distribution of the fuel is obtained. Fuel may be placed at any required point on the surface of the fuel bed by using either one deflecting vane only, or by adjusting the speed of the rotating discs.

The top cover of the producer is supplied with a number of inspection holes (closed by loose plugs) through which the contents of the producer may be viewed, or poking may be effected.

The circular grate (see fig. 2) is in three sections, all capable of rotation in the same (horizontal) plane. The sections—centre, inner, and outer—are mounted on ball bearings, and are driven by a common shaft. They are geared so that, approximately, while the outer ring makes one complete revolution, the inner ring makes two, and the centre three.

In each section of the grate are openings covered by rectangular slotted hoods, partly open on two sides, the openings facing in the direction of rotation and towards the centre respectively. The rotation of the grate allows the ashes to fall through the ports and through the space between the grate and the annular casing into the ash pan below. When the producer is on full work the grate is usually run for thirty minutes in each hour (dependent upon height of ash bed), and in these circumstances, the outer grate makes one complete revolution in 4½ hours, the inner grate in 3 hours, and the centre in 1¾ hours.

The lower part of the producer tapers downwards (from about 4 ft. below the grate) and is sealed by the water in the ash pan, which is also capable of rotation, the ashes being removed by an angle plough.

The air blast, after passing over the water at the top of the casing, is admitted under the grate, and enters the producer through the openings and slots in the ash port covers, even distribution being further effected by its passage through the bed of ashes. Provision is made for adding extra steam to the blast, but in our experience this has not been necessary.

The gas is taken off by a downtake pipe from the side of the producer at the top, the downtake pipe terminating in a water seal. Air is supplied by a blower driven by the same motor which drives the exhausters. The quantity of air is regulated by a bell float governor in communication with the gas outlet, movements of the governor being in turn communicated to a butterfly valve which regulates the air supply, the surplus air from the blower being allowed to escape. By this arrangement, variations in demand, which cause corresponding variations in pressure at the top of the producer, are rapidly met. The exhauster is provided with a by-pass, and a definite pressure is maintained on the main pressure supply pipe. Moreover, the bell float governor is so set as to maintain the pressure at the top of the producer at approximately atmospheric. Hence, when the inspection holes are open, there is no in-drawing of air or emission of gas.

Such a producer is capable of dealing with from ten to twelve tons of fuel per day, producing up to 1¾ million c.ft. of gas, with a calorific value of 115-130 B.Th.U. gross per c.ft. It may also be successfully operated to give a make as low as 100,000 c.ft. per day. The normal fuel consumption is about 10 lbs. per sq. ft. of grate area per hour.

The producer as originally erected was put to work in May, 1925, but it was found necessary to shut down after a few weeks working owing to the accumulation of clinker. This appeared to be due to two causes:

1. The fusion point of the ash was lower than that previously encountered on the Continent in this type of producer.
2. The angle of repose of the ashes was such as to prevent them from falling through the various openings at the desired rate.

Ultimately the following alterations were made:

(*a*) The grate hoods were raised and the openings enlarged to allow for the lower angle of repose of the ashes.

(*b*) Cutting "knives" were fixed on some of the hoods and others on the lower edge of the producer shell, with the object of breaking up the clinker.

The producer, as now constructed, works very satisfactorily,

and there is no ash nor clinker trouble whatever. An improvement has also been made in the fuel distributor by adding a variable gear giving three speeds. This allows better control of the rate of feeding and also of the " placing " of the fuel in the producer.

It has been suggested by the present Chief Engineer of the Manchester Corporation Gas Department that further improvement in the operation of the producer might be made by the provision of such arrangements as would permit one or all three rings of the revolving grate to move independently.

Starting and Operation.

When starting the producer, the water jacket and all the water seals are first filled, and a layer of about 20 in. of good dry ashes is spread on the grate. A wood fire is then lighted on the ashes, and when the wood is well ignited a thin bed of small graded coke is added. After a short interval the blower is gently brought into operation. When a good fire has been built up by gradually adding coke and increasing the air pressure, charging with breeze is commenced, and finally the full plant is brought into operation. During the early stages the gas is allowed to escape to atmosphere by opening a by-pass valve provided for the purpose. The balance of the air regulating valve is so adjusted as to maintain atmospheric pressure at the top of the producer. The fire should be charged " little and often " when the dull-red fuel bed becomes a little bright.

The appearance of distinct bright spots in the fuel bed indicates the formation of channels or chimneys. Such spots are at once covered with breeze and lightly stamped, pricking and further stamping being resorted to if necessary. Channels must always receive immediate attention, since they indicate local heating, with the consequent ash fusion and deterioration of the quality of the gas.

The grate is usually run for, say, thirty minutes in every hour, or for such periods as may be necessary to maintain the level of the ash bed and to keep the ashes broken and free. The normal depth of the fuel bed is about 6 ft., of which about 2 ft. to 3 ft. is ashes.

In order to arrive at the amount of ashes withdrawn by each ring, a test was made on a standing producer. Three feet of ashes were spread on the grate, and suitable arrangements were made for collecting the ashes from each ring. The grate was set in motion, and the proportions were found to be as follows :

Discharged by—	P.ct. of Total Ash Discharge.	P.Ct. of Total Discharge per Unit Area of Grate.
Centre grate . . .	9·5	24·1
Inner grate	32·5	33·6
Outer grate. . . .	58·0	42·3

The evaporation in the jacket is made up by the regular addition of water. Any surplus water overflows from the jacket into the ash pan, but large quantities of water added intermittently cause sudden cooling of the jacket. This is both unnecessary and undesirable, and should therefore be avoided.

Purification.

The object of the purification or cleansing of the gas is, of course, the removal of the tarry matter, dust, &c., and, if necessary, surplus moisture. The question of the plant necessary for the sufficient cleaning of the gas is still under consideration.

At Moll (Belgium) the gas is sprayed with water in the downtake pipe immediately on leaving the producer, after which it passes through a washer, then through a scrubber, and lastly through a drier.

At Partington, the purification process (designed for eight producers, of which six have been erected) consists of the following :

1. Three water sprays on each downtake pipe, which is 30 in. in diameter.
2. One water spray in each uptake pipe (leading from the seal at the bottom of the downtake pipe).
3. One water spray at the junction of the uptake pipe with the common collecting main.
4. A tower constructed on the venturi principle, and having a cyclone water spray arrangement. At this point a considerable portion of the dust and tar is precipitated.
5. The gas now passes up a coke filled tower normally fed with water. If, however, excessive back pressure develops, anthracene oil is used to remove the tar.
6. Then follows a Livesey washer, originally using water but now operated with spent gas oil (from the naphthalene washer). From this point the gas passes to the exhausters, after which follows :
7. A safety seal, before distribution.
8. A drier, which owing to excessive back pressure is out of use.

The water used is circulated, with a view to economy. It is slightly alkaline and is saturated with CO_2 and H_2S. It also contains a small quantity of suspended solids in a very finely divided state, the solid matter consisting of coke ash dust, coke dust, sulphur, and a small quantity of tarry matter. Course sand has been found to be a satisfactory filtering medium should it prove necessary to remove the solids before recirculation.

At Bradford Road the existing arrangements are as follows : The downtake pipe from the producer contains three water sprays, and the uptake pipe from the water seal has one.

The gas now enters the scrubber, which is packed with wooden grids, and is fed by water from seventeen points. Above the scrubber is a dry chamber packed with wooden grids, through which the gas passes before reaching the exhauster. The main leading to the exhauster has one anthracene oil spray, while anthracene oil is also fed to the exhauster itself. The main from the exhauster is sprayed at three points with anthracene oil, and the gas finally passes upwards through a " tar extractor," which consists of a length of pipe packed with Raschig rings and fed with anthracene oil through one spray. Finally the gas passes to a safety water seal before reaching the meter and the distributing mains.

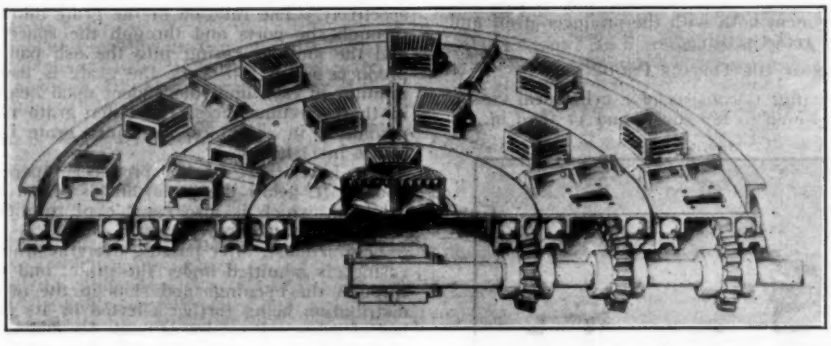


FIG. 2.

Experiments in the direction of simplifying the cleaning process are in hand, for the arrangements, at least at Partington, appear to require modification.

The experimental plant erected at the Bradford Road Works consists of a series of pipes with (inside) water sprays to remove dust and to cool the gas. A further pipe, fitted with one or more anthracene oil sprays follows, then comes the exhauster, and finally a pipe packed with 6 ft. of Raschig rings, the pipe being of such restricted diameter as will give a back pressure of 3 in. to 4 in. W.G. If successful, this would simplify the plant considerably, and lower the cost by abolishing the tower scrubber, washer, &c.

No attempt is made to remove the sulphuretted hydrogen other than that dissolved in the water during cleaning. The amount present varies between 100 and 150 grains per 100 c.ft. of gas. The amount of sulphur burnt in the settings is approximately the same as that produced by the ordinary producer burning coke.

General Comments on the Working of the Producer.

Size of Fuel.

The producer has been successfully operated on all grades of coke breeze, with the exception that a trial made using our No. 1 Breeze (all of which passes $\frac{5}{16}$ in. screen) was unsuccess-

ful owing to the high resistance offered to the passage of the blast. Other grades of breeze containing up to 40 p.ct. passing through ¼ in. mesh have been utilized with complete success.

It should be noted that the portion below ¼ in. contains a considerable amount of very fine material, but when this is mixed with breeze over ¼ in. it gives no trouble.

Dust.

The use of breeze containing even a portion which passes through ¼ in. sieve naturally raises the question of the dust in the gas, and the higher the percentage of breeze passing through ¼ in. the more serious one would anticipate the dust question to be.

We have not, however, found any difficulty from this source, even with the smallest fuel we have used. The amount of dust leaving the producer is comparatively small, as is indicated by Table 1, varying with the grade of fuel in use. We attribute this comparative freedom from dust to the fact that the gas at the top of the producer is at practically atmospheric pressure, and also that there is a large volume above the fuel bed in the producer through which the gas travels comparatively slowly. Hence the tendency for dust to be carried forward by the gas is reduced to a minimum.

Moisture and Ash in Fuel.

These have little, if any, effect on the working of the producer, and we have used fuel in which the combined moisture and ash have been as high as 39 p.ct. The quantity of gas made per 1 lb. of fuel (as used) naturally varies with the moisture and ash content.

Regulation of the grate in accordance with the amount of ash in the fuel is simple, and we have experienced no difficulty

TABLE No. 1.—*Trefois Producer Gas Plant.—Partington.*

Dust, &c., and Tarry Matter Deposited at Various Points.

Location.	Wt. of Dry Deposit / Wt. of Fuel Used	Analysis of Dry Deposit: Coke Dust, &c.	Analysis of Dry Deposit: Tarry Matter	Dry Deposit Fuel Used: Coke Dust, &c.	Dry Deposit Fuel Used: Tarry Matter	Remarks.
	P.Ct.	P.Ct.	P.Ct.	P.Ct.	P.Ct.	
No. 1 producer sump .	0·120	98.4	1·6	0·118	0·002	Town water sprays, gas temp., uptake 65° C.
No. 3 producer down-take sump	0·090	98·0	2·0	0·088	0·002	Town water spray, gas temp—270°-290° C., uptake 70° C.
Main overflow sump. .	0·006	68·3	31·7	0·004	0·002	Circulating water sprays. High velocity of water at this point causes most of the deposit to be carried to settings tanks. This sump serves both No. 1 and No. 3 producers.
Venturi tower sump. .	0·056	25·1	74·9	0·014	0·042	This sump serves both No. 1 and No. 3 producers.

TABLE No. 2.—*General Working Results—Trefois Producer.*

	Experimental Plant—Bradford Road.						Partington.
Reference	A.	B.	C.	D.	E.	F.	G.
Fuel used	Breeze. Horizontal. Through 1 In.	Breeze. Horizontal. Through 1 In.	No. 3's. Broken Coke. (¾ In. to 1¼ In.)	Breeze. Horizontal. Through 1 In.	50 P.Ct. Breeze. Horizontal. 50 P.Ct. Recovered Coke (Pan Ash) Breeze.	No. 2's. Broken Coke. Over ¾ In. through 1¼ In.	Breeze. Vertical.
Screening—							
Over 1 in., p.ct. . . .	..	..	..	9·7	11·4	..	..
,, ½ ,, ,, . . .	..	..	..	17·5	21·9	29·0	..
,, ¼ ,, ,, . . .	..	..	..	40·0	46·0	58·0	88·4
Under ¼ in. ,, . . .	..	..	..	32·8	20·7	13·0	11·6
Analysis—							
Moisture, wet basis, p.ct.	16	16	10·4	15·0	18·4	5·1	11·6
Ash ,, ,, ,,	13	13	9·2	12·9	20·8	12·4	11·86
C.V.M. ,, ,, ,,	..	..	2·3	4·0	2·3	3·3	1·96
Cal.val., dry ,,B.Th.U.	11,100	11,300	12,750	11,875	10,420	12,270	12,120
Results—							
Total fuel used . . .	76 tons 18 cwt.	298 tons 14 cwt.	22 tons 6 cwt.	70 tons 7 cwt.	55 tons 17 cwt.	40 tons 8 cwt. 3 q.	370 tons 11 cwt.
Gas made corrected, c.ft.	9,547,600	35,729,300	3,726,800	10,486,000	7,829,000	7,463,000	55,915,000
Cal. val., B.Th.U. gross	122	120	121	121	114	125	125
Total therms made . .	11,648	42,875	4,509	12,688	8,925	9,329	69,894
Gas Analysis—							
CO_2, p.ct.	..	..	..	10·2	11·1	8·6	10·7
O_2 ,, ...	..	..	..	*Nil*	0·3	0·4	*Nil*
CO ,, ...	..	..	..	20·8	19·8	23·0	20·8
CH_4 ,, ...	..	..	..	0·7	1·1	1·1	0·7
H_2 ,, ...	..	..	..	13·2	11·4	13·8	15·6
N_2 ,, ...	..	..	..	55·1	56·3	53·1	52·2
Steam sat., temp. ° C. . .	..	..	..	69	67	68	70
Extra steam used . . .	..	..	..	*Nil*	*Nil*	*Nil*	*Nil*
P.ct. steam decomposed (approx.)	..	..	..	48	41	54	49
P.ct. carbon in ashes (dry)	..	23·5	2·6	16·0	5·8	14·3	3·9
P.ct. carbon lost/carbon in fuel	..	5·6	0·31	3·4	2·1	2·5	0·71
Summary—							
Gas made per ton—							
Fuel as charged . .	124,104	119,622	167,121	149,055	140,179	184,556	150,897
Dry fuel	147,743	142,405	186,519	175,359	171,788	194,474	170,698
Dry ashless fuel . .	174,935	168,482	207,862	204,465	230,557	223,704	197,148
Gas made per lb.—							
Fuel as charged . .	55·4	53·4	74·6	66·5	62·6	82·4	67·4
Dry fuel	66·0	63·6	83·3	78·3	76·7	86·8	76·2
Dry ashless fuel . .	78·1	75·2	92·8	91·3	102·9	99·9	88·0
Therms per ton—							
Fuel as charged . .	151·4	143·5	202·2	180·4	159·8	230·7	188·6
Dry fuel	180·2	170·9	225·7	212·2	195·8	243·1	213·3
Dry ashless fuel . .	213·4	202·2	251·5	250·2	262·8	279·6	246·4
*Gas efficiency	72·5	67·5	79·0	79·8	83·9	88·5	78·6

* Ratio: $\frac{\text{Therms in gas made}}{\text{Therms in fuel used}}$

with clinker since the earliest days of the working of the plant to which reference has already been made.

Tarry Matter.

In the experimental stages of the working of the producer some difficulty was experienced with tarry matter. The tar is thick and sticky, and on standing sets to a hard mass. A sample was examined and the following results were obtained:

—	—	On Dry Tar.
	P.Ct.	P.Ct.
Water (entrained)	43·0	..
Oil (extracted by solvent)	41·5	72·8
Solid matter	15·5	27·2

The oily matter is apparently of the paraffin type, having a decided "bloom," the solid matter being a smooth black powder containing 66 p.ct. of free carbon and 34 p.ct. of ash.

This difficulty has been largely overcome by spraying with anthracene oil, as previously described. The oil acts, at least partially, as a solvent, keeping the tarry matter fluid. The quantity of oil used is very small, amounting to 1½ to 2 gallons of anthracene oil per million c.ft. of producer gas, part of the oil being removed at prescribed periods and replaced by fresh oil.

Water in the Gas.

Although in some cases only 50 p.ct. of the steam used is decomposed in the producer, the cooling and cleansing system reduces the moisture in the final gas to the normal saturation point. Drainage for condensed water is provided on the gas mains to the settings, and no trouble from this source is experienced in the use of the gas. It has, however, occasionally proved necessary to clear these mains of tarry matter. The gas enters the settings by pipes passing through the brick wall into the regenerators, as will be briefly described later.

RESULTS OF TESTS.

Table No. 2 gives the results of tests made with various classes of fuel, while Table No. 3 gives similar data from Continental installations.

TABLE NO. 4.—*Experimental Plant at Bradford Road Works.*

Repairs and Maintenance Charges.

[Costs Include Experimental Alterations.]

—	March 31, 1928.	March 31, 1929.	March 31, 1930.	Total.
Gas made, 1000 c.ft.	528,883	472,025	307,906	1,308,814
Fuel used (wet), tons	3,264	3,588	1,988	8,840
Calorific value, average	118	115	112	116
Therms produced	623,457	501,225	312,107	1,441,728
	£	£	£	£
Materials	98	88	60	246
Wages	237	210	179	626
Total	335	298	239	872
	d.	d.	d.	d.
Per 1000 c.ft. gas—				
Material	0·044	0·045	0·047	0·045
Wages	0·107	0·107	0·140	0·115
Total	0·151	0·152	0·187	0·160
Per ton fuel (wet)—				
Material	7·2	5·9	7·2	6·7
Wages	17·4	14·0	21·6	17·0
Total	24·6	19·9	28·9	23·7
Per therm—				
Material	0·038	0·042	0·046	0·041
Wages	0·091	0·101	0·138	0·104
Total	0·129	0·143	0·184	0·145

by this table, one producer has been fitted with a new top (the cost of which is included in the statement) and at the moment it is shut down for the fitting of a new body at an estimated cost of £280.

No major repairs to the grate or other equipment of the producer have been necessary. The repairs and maintenance costs are thus seen to be light, amounting to an average of 0·16d. per 1000 c.ft., or 23·7d. per ton of fuel used.

TABLE NO. 3.—*Results obtained at some Continental Installations.*

General Working Results.

Size	P.Ct. Through 0·28 in. = 15 ,, 0·28 in. to 1·2 in. = 46 ,, over 1·2 in. = 39	0 to 0·28 in. = 26·7 0·28 in. to 1·2 in. = 73·3	0 to 0·08 in. = 15·3 0·08 in. to 0·28 in. = 13·6 0·28 in. to 0·79 in. = 19·8 over 0·79 in. = 51·3	1·6 in. to 2·4 in.	0·8 in. to 1·6 in., 8 P.Ct. of which through 0.2 in. Screen.	0·2 in. to 0·8 in., 20 P.Ct. of which through 0·2 in. Screen.
Analysis of fuel used—						
Wet basis, moist, p.ct.	15·5	13·0	27·5	5·2	1·9	7·3
,, ,, ash, p.ct.	10·1	16·0	11·0	26·0	26·3	27·1
,, ,, C.V.M., p.ct.	..	1·3	1·0	3·0	2·0	2·6
Dry basis, cal. val., gross	..	..	12,546	..	..	..
,, ,, ,, ,, net	..	..	..	10,620	10,638	10,476
Analysis of gas made—						
CO_2, p.ct.	10·3	9·87	10·9	12·4	11·9	8·7
O_2, ,,	0·0	0·0	0·0	0·4	0·4	0·95
CO, ,,	21·35	20·69	18·33	15·1	18·8	20·4
CH_4, ,,	0·0	1·36	1·3	0·75	0·6	0·8
H_2 ,,	16·35	14·18	16·23	18·3	18·5	18·7
N_2 ,,	52·0	53·90	53·24	53·05	49·8	50·45
Cal. val., gross per c.ft., B.Th.U.	129	..	134·6	123	135	143
,, ,, net ,, ,,	119	..	124·2	..	..	..
Extra steam used—						
P.ct. wt. of steam/wt. of fuel as used	38·8	37·9	52·6	73·2	59·2	42·6
Gas made—						
Per 1 lb. fuel as charged	68·7	64·8	50·5	67·9	58·9	52·0
,, ,, ,, dry	81·28	..	69·6	71·5	60·0	56·16
Efficiency, exclusive of extra steam p.ct.	76·9	..	70·6	76·0	75·2	87
Efficiency allowing for extra steam p.ct.	72·5	..	..	72·2	72·5	85

LABOUR.

At Partington Works, to attend to the 6 producers, there are 9 operators (three on each shift), 3 other shift men, and 2 assistants, the total being 14. The cost of wages amounts to 0·26d. per 1000 c.ft., equal to 0·21d. per therm or 39·3d. per ton of fuel used.

REPAIRS AND MAINTENANCE.

The plant at the Partington Works has been in operation for so short a period that no information can be given as to the cost of repairs, &c. Consequently, in the statement of costs for that works no such item appears.

Table No. 4 gives an analysis of the repairs and maintenance costs at the Bradford Road Works. During the period covered

TOTAL COST OF PRODUCTION.

In the case of the Bradford Road Works, the particulars covering the three years ended March 31, 1928, 1929, and 1930, have been abstracted and are included in the statement in Table No. 5. Table No. 6 gives similar particulars for the Partington installation.

UTILIZATION OF PRODUCER GAS.

It will be commonly conceded that the calorific value of the coal gas from horizontal retort installations should not be lower than 500 B.Th.U. gross per 1 c.ft. and preferably higher. Any reduction in this quality should be made by dilution, rather than by, for example, over-pulling.

Producer gas is eminently suitable for this purpose. The

—MANCHESTER CORPORATION GAS DEPT.—
—BRADFORD ROAD WORKS—
—FURNACE AND SETTING OF 10/5—
—FIG 3.—

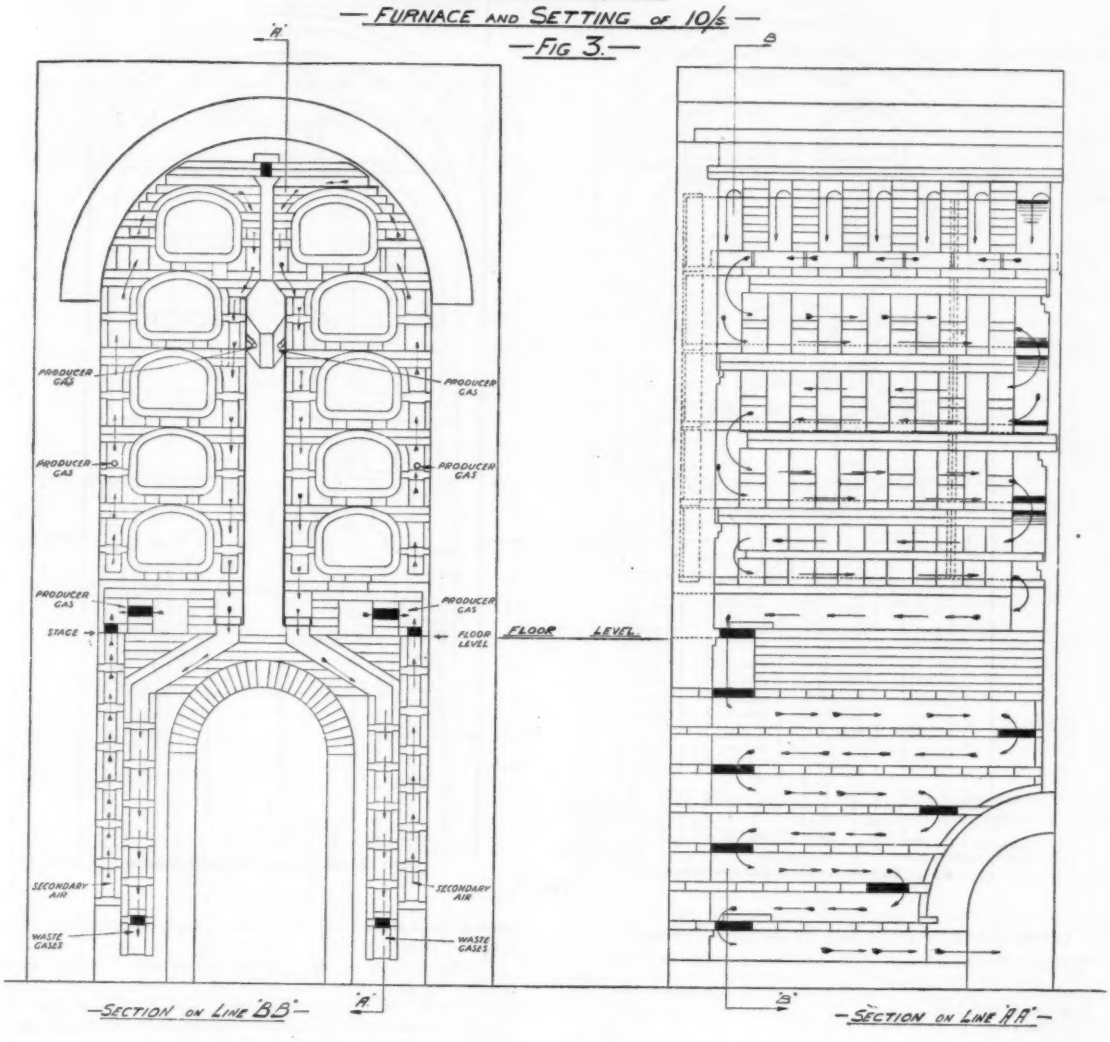


TABLE NO. 5.—*Experimental Trefois Gas Producer Plant—Bradford Road Works.*

Working Results and Costs from April 1, 1927, to March 31, 1930.

Year ending	March 31, 1928.	March 31, 1929.	March 31, 1930.	Total. Three Years.
Days working	337	331	287	955
Fuel used, tons (wet), total	3,264	3,588	1,988	8,840
Consisting of ordinary breeze, p.ct.	60·7	29·9	28·6	41·0
Recovered breeze, p.ct.	6·9	22·8	19·9	16·3
Unwashed 2's and 3's, p.ct.	32·4	47·3	51·5	42·7
Gas made, total, 1000 c.ft.	528,354	435,848	278,667	1,242,869
Calorific value, average	118	115	112	116
Therms made, total	623,457	501,225	312,107	1,441,728
Gas made per 1 lb. fuel, c.ft.	72·3	54·2	62·6	62·8
Therms made per ton	191	140	157	163
Costs—	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Average price of fuel per ton	0 6 1½	0 3 10	0 4 4	0 4 7½
Total cost of fuel	999 0 0	688 0 0	431 0 0	2118 0 0
Attendants' wages	643 0 0	643 0 0	687 0 0	1973 0 0
Electricity (0·5d. per unit)	139 0 0	136 0 0	95 0 0	370 0 0
Water (8½d. per 1000 galls.)	24 0 0	31 0 0	29 0 0	84 0 0
Sundries	22 0 0	29 0 0	20 0 0	71 0 0
Haulage of fuel	61 0 0	80 0 0	57 0 0	198 0 0
Repairs and Maintenance—				
Material	98 0 0	88 0 0	60 0 0	246 0 0
Wages	237 0 0	210 0 0	179 0 0	626 0 0
Total cost	£2223 0 0	£1905 0 0	£1558 0 0	£5686 0 0
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Total cost per ton of fuel used	0 13 7½	0 10 7½	0 15 8	0 12 10½
,, ,, ,, 1000 c.ft.	0 0 1·0	0 0 1·0	0 0 1·3	0 0 1·1
,, ,, ,, Therm.	0 0 0·86	0 0 0·91	0 0 1·2	0 0 0·95

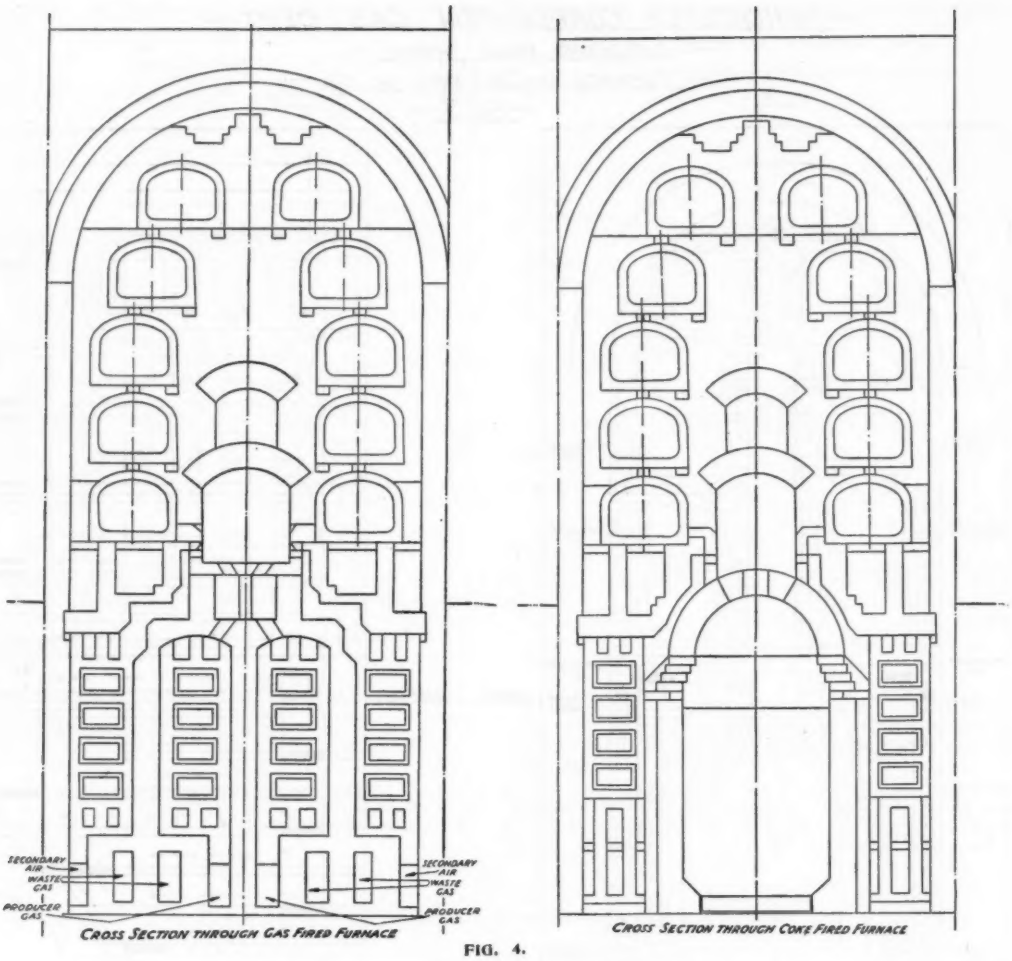


FIG. 4.

TABLE No. 6.—*Trefois Gas Producers—Partington.*

Working Results and Costs from Jan. 16 to 22, 1930, inclusive.

Fuel used		370 tons 11 cwt.	
Gas made, 1000 c.ft.		55,915	
Calorific value, gross B.Th.U. per c.ft.		125	
Therms made		69,709	
Gas made per 1 lb. fuel (wet), c.ft.		67·4	
Therms made per ton		188	
Costs—	£	s.	d.
Price of fuel, per ton	0	6	0
Total cost of fuel	111	3	4
Attendant's wages	60	13	4
Electricity (0·61d. per unit)	29	18	2
Water (11¾d. per 1000 galls.)	26	3	8
Sundries	3	0	0
Anthracene oil (9¼d. per gall.)	3	1	8
Waste gas oil (1d. per gall.)	2	6	8
Total cost	£236	6	10
Total cost per ton of fuel	12s. 9d.		
,, ,, ,, 1000 c.ft. gas	0s. 1·01d.		
,, ,, ,, therm	0s. 0·81d.		

effect on the composition and the calorific value of the gas may be judged by the following table:

—	* Horizontal Retort Gas.	Trefois Producer Gas.	Mixture.
	P.Ct.	P.Ct.	P.Ct.
CO_2	2·0	10·0	4·0
O_2	0·4	0·2	0·35
C_nH_m	3·6	*Nil*	2·7
CO	8·0	21·2	11·3
CH_4	30·0	1·0	22·75
H_2	52·0	12·8	42·2
N_2	4·0	54·8	16·7
Cal. val., gross B.Th.U.	559·8	119	449·6
,, ,, net ,,	499·3	111	402·2
P.ct. coal gas in mixture	100	*Nil*	75
P.ct. producer gas in mixture	*Nil*	100	25

* From "Technical Data on Fuel."

The maximum combustion temperature of the mixture is shown by calculation to be not much lower than that of the original coal gas.

Producer gas is an almost universal heating medium in gas-works practice, but whereas in most cases producers of the "built in" type are used, the producer gas from the Trefois producers has been successfully utilized for heating horizontal retort settings as well as coke ovens.

There are obvious advantages in the use of outside producers employing breeze rather than built in producers using the coke direct from the retorts (*i.e.*, 85 p.ct. best coke and 15 p.ct. breeze). Control of the heating is more effective, requiring only the manipulation of the producer gas supply and the adjustment of the air supply correspondingly, to maintain temperatures and to keep the waste gas constant with a minimum of surplus air. Variation in the quality and quantity of the gas from "built in" producers is almost inevitable.

On the other hand, there may be some loss of heating efficiency arising from the use of cold gas, as against charging the producer with hot coke and utilizing the hot gas direct from the producer, but the advantages to be gained outweigh any disadvantages.

Experiments at Bradford Road.

In the case of the experiments at the Bradford Road Works there are two types of settings. One is the normal Drakes type retaining the normal tubular regenerator. In this case, half the producer gas and half the air respectively enter on each side of the regenerator, both being heated by the waste gases in the usual way.

The other type has, in addition to the ordinary type of regenerator, a special regenerator for heating the producer gas built into the position formerly occupied by the producer (fig. 4). No difficulty has been experienced in working either type of setting.

An examination of the flues, combustion chamber, &c., in the Bradford Road settings shows that on the whole there is very little deterioration in the brickwork.

At the Partington Works, the settings follow the broad lines of the second type described above.

A summary of the tests made at the Bradford Road Works on gas fired settings is given in Table No. 7, while the results of tests made at Partington Works are given in Table No. 8.

Experiments are in hand at the Bradford Road Works with settings of 10's (18 in. by 24 in. by 23 ft. retorts) heated by regenerated air, and cold producer gas at various points (fig. 3).

TABLE No. 7.—*Summary of Tests made on Experimental Gas-Fired Settings at Bradford Road.*

Nos. 22 and 23 Beds "A" House Horizontal Retorts.

Aug. 9 and 10, 1927.

Description of Settings.

No. 22. Drakes regenerator. All air entering one side of producer arch and all gas the other.

No. 23. Drakes regenerator; modified setting with additional regenerator for gas.

10 retorts per bed in each case (in rows of two, 5 high).

Producer Gas Used, &c.

—	No. 22 Bed.		No. 23 Bed.		Totals, &c.
	Aug. 9.	Aug. 10.	Aug. 9.	Aug. 10.	
Quantity, c.ft.	556,040	568,710	485,070	519,690	2,129,510
Equivalent to breeze used (wet), tons	3·327	3·403	2·9025	3·110	12·7425
Analysis—					
CO_2 by vol., p.ct.	..	..	..	..	8·5
O_2 ,, ,, ,,	..	..	..	..	0·9
CO ,, ,, ,,	..	..	..	..	21·2
CH_4 ,, ,, ,,	..	..	..	..	0·5
H_2 ,, ,, ,,	..	..	..	..	14·8
N_2 ,, ,, ,,	..	..	..	..	54·1
Calorific value, gross B.Th.U. per c.ft.	120	122	120	122	121
Therms, total	667	694	582	634	257·7
Temperature of gas entering setting, °C.	29·5	29·5	29·5	29·5	29·5

NOTE.—Gas made per 1 lb. fuel as charged = 74·6 c.ft.
,, ,, ,, 1 lb. ,, dry = 83·4 ,,

$$\frac{\text{Therms in gas made}}{\text{Therms in fuel used}} = 79{\cdot}1 \text{ p.ct.}$$

Temperatures of Combustion Chambers.

Date.	Side of Setting.	Position, &c.	No. 22 Bed.	No. 23 Bed.
Aug. 9.	Charging side	Highest temp., °C.	1290	1275
		Lowest ,, ,,	1250	1200
		Backwall highest, ,,	1230	1230
		,, lowest, ,,	1170	1200
	Discharging side	Highest temp., °C.	1300	1300
		Lowest ,, ,,	1250	1240
		Backwall highest, ,,	1250	1270
		,, lowest, ,,	1220	1250
Aug. 10	Charging side	Highest temp., °C.	1340	1310
		Lowest ,, ,,	1240	1240
		Backwall highest, ,,	1280	1260
		,, lowest, ,,	1225	1215
	Discharging side	Highest, °C.	1340	1310
		Lowest, ,,	1265	1245
		Backwall highest, ,,	1330	1290
		,, lowest, ,,	1240	1265

Waste Gases (Averages).

Aug. 9 . . No. 22 Bed, CO_2 = 19·0 p.ct. } O_2 usually under 1 p.ct.
,, 10 . . No. 22 Bed, CO_2 = 19·0 ,, } CO seldom present.
,, 9 . . No. 23 Bed, CO_2 = 14·0 ,, } CO seldom present,
,, 10 . . No. 23 Bed, CO_2 = 18·0 ,, } balance O_2 (and N_2).

Coal Carbonized—Analysis.

—	Aug. 9.	Aug. 10.	Average.	
			Wet Basis.	Dry Basis.
Moisture, wet basis, p.ct.	6·0	4·8	5·4	..
Ash, wet basis, p.ct.	6·3	5·4	5·85	6·2
Comb. vol. matter, wet basis, p.ct.	32·9	31·8	32·35	34·2
"Coke," wet basis, p.ct.	61·1	63·4	62·25	65·8
Cal. val., dry basis, B.Th.U. per lb.	13,800	14,100	..	13,950

Remarks: Caking coal, slight swelling, light brown ash.

Weight of coal carbonized (wet), tons	80·625
Weight of coke produced (dry), tons	57·33 = 71·1 p.ct.
Cal. val. of coke, B.Th.U. per lb. (dry)	12,950
Therms in coke produced	16,630
Volatile matter in coke produced (dry)	2·9 p.ct.
Duration of charge	12 hours.
Number of charges	80
Weight of each charge, coal	20·1 cwt.
Weight of coke from each charge	14·33 cwt.

Equivalent Breeze Used for Carbonization.

Weight of breeze used per ton of coal carbonized . . 3·16 cwt.

$$\frac{\text{Breeze as used}}{\text{Coal as charged}} = 15{\cdot}8 \text{ p.ct.}$$

$$\frac{\text{Dry breeze}}{\text{Coal as charged}} = 14{\cdot}1 \text{ p.ct.}$$

TABLE No. 8.—*Summary of Tests on Gas Fired Settings at Partington.*

Jan. 16—22 inclusive, 1930.

Description of Settings.

Drakes regenerator; modified with additional regenerator for gas.
10 retorts per bed in rows of two and 5 high.

Producer Gas Used, &c.

Quantity, c.ft.	51,635,000
Equivalent to breeze used (wet), tons	342·14
Analysis—	
CO_2, p.ct.	10·7
O_2, ,,	Trace
CO, ,,	20·8
CH_4, ,,	0·7
H_2, ,,	15·6
N_2, ,,	52·2
Calorific value, gross, B.Th.U. per c.ft.	125
Therms used (total)	64,540

NOTE.—Gas made per 1 lb. of fuel as charged = 67·4 c.ft.
,, ,, ,, 1 lb. ,, dry = 76·2 ,,

$$\frac{\text{Therms in gas made}}{\text{Therms in fuel used}} = 78{\cdot}6 \text{ p.ct.}$$

Temperatures of Combustion Chambers.

Average	1350° C.
Maximum	1430° C.

Coal Carbonized.

Weight of coal carbonized (wet), tons	1656
Duration of charge, hours	16
Number of charges	1680
Weight of coal per charge, cwt.	19·7

Equivalent Breeze Used for Carbonization.

Weight of breeze used per ton of coal carbonized = 4·13 cwt.

$$\frac{\text{Breeze as used}}{\text{Coal as charged}} = 20{\cdot}6 \text{ p.ct.}$$

$$\frac{\text{Dry breeze}}{\text{Coal as charged}} = 18{\cdot}2 \text{ p.ct.}$$

The whole of the air is admitted at the entrance to the setting, and varying amounts of producer gas are added at different points along the heating flues.

Doubt has been expressed as to whether the use of cold producer gas will allow the attainment of a sufficiently high temperature for carbonization.

A study of the theoretical combustion temperatures, however, suggests that, while cold air and cold producer gas are not likely to give a sufficiently high temperature, the preheating of either to, say, 600° C., gives ample margin. We think therefore that there is every justification for the experiment of using regenerated air and cold producer gas on the lines indicated.

It has been suggested to us that the producer gas might be used directly from the producer (*i.e.*, without the intervention of the cleaning plant and its consequent cooling) and without regenerators. The issue appears to be doubtful for the following reasons:

(*a*) The gas leaves the producers at about 350° C. or less. Some cooling would inevitably occur prior to the burning of the gas, and it is doubtful whether a sufficiently high combustion temperature could be maintained for the heating of the retort settings.

(*b*) While we should not anticipate serious difficulty arising from the presence of dust in the gas, the tar might give trouble by blocking the distribution pipes.

The preliminary work in these directions revealed the absolute necessity for care in the construction of the regenerators, and particularly for the use of the best jointing material.

SUMMARY.

The Trefois producer installed experimentally at the Bradford Road Works has proved completely satisfactory for the manufacture of producer gas from materials which would otherwise have been practically useless. All grades of fuel, including that of small size or of high moisture or of high ash content, may be utilized. An average yield may be expected of about 65 c.ft. of producer gas of a calorific value of about 120 B.Th.U. gross per c.ft. from each pound of fuel (as charged).

The control of the producer is simple, its flexibility as regards both material used and output is very great, and its efficiency at all loads is high.

The dust and tar problems, while not perhaps completely solved, are, we are confident, capable of solution, and meanwhile are giving no serious difficulty. It was also shown by the Bradford Road experiments that the use of the Trefois producer gas for the heating of the horizontal retort settings was practicable; and the plant at Partington Works is already justifying this conclusion. The cost of manufacturing the

producer gas is low, and its use for the heating of the settings represents substantial economies in the costs of carbonization.

Among the many advantages to be gained by the use of gas fired settings, we would suggest the following:

1. An alteration in the design of the setting resulting in lower capital costs.
2. Simpler operation of the setting.
3. Greater measure of control.
4. Financial economies resulting from 2 and 3.
5. Longer life of settings.
6. Lower operating costs, since there are no fires to be clinkered, &c.
7. No loss of fuel in the ashes as with the usual type of "built in" producer.
8. The utilization of a cheap fuel.

Conclusion.

In presenting this paper we are fully conscious of its deficiencies. The comparatively short period of operating the large-scale plant at the Partington Works has prevented the presentation of as complete data as we wished. We believe, however, that the information we have given is sufficient not only to justify its presentation, but also to justify confidence in the complete plant, both producers and settings.

On the purely scientific side of our subject, too, we are equally conscious of deficiencies. We should have liked to present, for example, a detailed study of the heat economy of both producers and settings, but circumstances have not given us that opportunity. We have felt, however, that the stage has been reached when we may usefully present the result of our experience so far, and we trust that this record of the work may prove not only of interest, but of service to the industry.

Mr. Applebee explained that the results given were presented just as they were obtained, and were not figures selected to prove a particular case. Sometimes, as with all plants, the producer was not working well, at other times it was, and the varying conditions were reflected in the figures. At its best the efficiency of the Trefois producer was excellent; even at its worst it was good. The prices given for fuel in the tables—particularly Nos. 5 and 6—were the prices actually charged against the plant on their own works; they would not necessarily represent the actual value of the breeze, still less the fair price at another works. They were regulated by the conditions at Bradford Road or at Partington, and did not necessarily apply elsewhere.

From the standpoint of quality and size, it was certain that the Trefois producer would handle a fuel which few, if any, other producers would. A particularly low-grade material was used. In some of the breeze the percentages of moisture and ash were extremely high. But in spite of this the efficiency was extremely good. This was one of the outstanding features of the Trefois producer. With regard to the heating of the setting, they certainly would not contend that all the possibilities in connection with the use of producer gas had been fully explored. The experiments in hand had not reached the stage of finality; they believed improvements were possible, and they would have something to say on that point later. Since the paper was printed, some of the experiments referred to had been running, and Mr. Holton would present the results of them.

Mr. Holton said it would not surprise him if, after reading the paper and visiting the works, the members came to the conclusion that the purification plant connected with producer gas needed some simplification. In the paper reference was made to experiments now being carried on at the Bradford Road Works—namely, the gas going immediately from the producer to simply four pipes of the same size as the outlet of the producer, in which were sprays for cooling the gas, and the final one, an anthracene oil spray for taking out the small amount of tar. This had been working for a fortnight, and it had given no trouble. It had been working on a 50 p.ct. load, but there was no reason to doubt that it would function quite satisfactorily on full load. So they anticipated getting rid of all the expensive purification plant that had been used hitherto.

Reference was also made in the paper to a special setting to be heated with cold producer gas. This was hardly an innovation. At the Rochdale Road Works of the Manchester Corporation they had a setting which Mr. Tooley, the Manager, installed there, but he did not regenerate the air. Good results were obtained. At Bradford Road they were now reversing, and trying with cold producer gas and heated air, and, theoretically at any rate, they ought to obtain good results. They would be getting definite data in the next few weeks; and if the Institution wished it he would present a written communication giving the definite results of what was now the experimental purification plant, and also of the setting heated with cold producer gas.

The President: We shall certainly wish to have it.

Mr. Holton said that for some time a setting had been under consideration. The separate ovens had no regenerators or furnaces. That meant a direct saving of approximately 40 to 50 p.ct. on the capital cost of each oven. Then in such a setting no stage floor was required, and the height of the house was correspondingly decreased, resulting in a further saving in capital cost. It would be definitely necessary to heat either the air or the gas. In the suggested setting the recuperators or regenerators were built at the end of the settings, and the coke oven was adapted with reversing valve.

With a definite object in mind, no comparative costs were given in the paper, though it contained sufficient data to enable anyone who was interested to obtain the cost of the heating of settings by the Trefois producer. A comparative statement had now been prepared which showed the cost of heating settings: (1) With regenerators and internal producers in accordance with the usual practice. (2) With regenerator and two Trefois producers, an example of which could be seen in the horizontal installation at Partington. In this case, as furnaces were not built in the setting, the height of the cellar need only be sufficient to allow comfortable passage room and also to provide for the regenerator floats. Thus there was a saving through the diminution in the height of the regenerator combination and consequently in the height of the house itself. (3) An example with the regenerator at each end, as suggested in the drawing.

The costs, which were common to all three systems, had been ignored, in order to simplify the statement. Interest and sinking fund on the additional plant required was provided; the sinking fund charged varied according to the estimated life of the respective portions of the plant. Labour costs were at the current rates. Fuel costs were estimated at 20s. per ton for coke and 5s. per ton for breeze. These prices did not operate in all undertakings. Therefore a table at varying prices had been prepared. Coke was taken at 24s. and breeze at 6s. The usual practice was that the breeze was a quarter of the price of coke; it had also been taken out at a third. The cost of repairs and maintenance had careful consideration. With the exception of the renewal of the top and body of each Trefois producer every five years, they were of opinion the annual charges under this item would be approximately the same for each of the three systems. Therefore they included in the costs an item for the renewal of the body and top of the producer; other repairs of the producer they ignored as common to all.

Credit was taken for surplus gas not required for heating the settings. Each producer was capable of gasifying 12 tons of breeze per day. The amount of gas produced would be 1,775,000 c.ft. per day. Making an allowance of 20 p.ct. for contingencies, the working figures were 1,400,000 c.ft. per day. Two producers had been allowed for in the capital cost, and from these two 2,800,000 c.ft. of producer gas would be obtained. For the amount of producer gas required for heating a high figure was 22,000 c.ft. per ton of coal carbonized.

Discussion.

The President said he was sure the members would agree that, in asking Mr. Holton and Mr. Applebee to give their report on the Trefois producer, he made a happy choice. One point in the paper was of particular interest to himself; this was the tar trouble, and how it was overcome. At Bolton they had been up against tar trouble in their experimental plant, where they were generating water gas in vertical retorts. They overcame the difficulty. They were able to keep the pipes clear by what he might almost term an indiscriminate use of creosote oil, but he was satisfied that if they had to carry out their experiment on a larger scale they would have to resort to some such method as that with which Mr. Holton had been dealing. It occurred to him that the purification plant seemed rather bulky, and looked as though it might be expensive; but the costs shown seemed to disprove this. Had Mr. Holton considered the Cottrell electrical precipitation plant, or did he suggest that it would not be suitable with such materials as were dealt with?

Mr. H. E. Bloor (York) said they all had to get experience; and he himself, like others, had had trouble with the disposal of breeze. He had no doubt this was a leading idea in the minds of the authors in taking an interest in this plant. It always seemed a great pity that a potential valuable fuel should be—entirely because of its physical state—practically a drug in the market, and should command such low prices to be in certain cases almost a waste product. He had more or less thoroughly investigated the claims of various methods of using breeze for firing settings, and they always seemed to be wanting in something until the Trefois producer came on the scene. Through the courtesy of Mr. Holton and the free way in which he was given access to the works, and the frank way in which Mr. Holton told all his experiences with the plant, he felt justified in putting before his Directors a proposition to install the Trefois producer plant. It was now being installed, and he hoped some day to tell the members something about it. Did Mr. Holton at the moment know anybody else who was installing the plant?

Mr. Holton: No.

Mr. Bloor said that if there were two places using this plant and both getting successful results from it, credit must be given to Mr. Holton for being the pioneer as far as this country was concerned; he would have set a ball rolling which would have very important economic results for the gas industry. It would also be a very great score for Manchester—one more to add to the many that Manchester had achieved—if it turned out that a producer had been introduced to this country which would make breeze really the valuable commodity they believed it to be, but of which they had never been able to convince buyers. At York they had horizontal and vertical retorts, and in the latter the formation of fine breeze, or dust, was a problem,

Of course, it was not suggested the Trefois producer would work with fine dust—Mr. Holton had given precise information about this in his paper—so he anticipated they would have to extract the fine dust, certainly from the vertical breeze. It would be an agreeable surprise to him if he found they could put the whole of the material as produced through the plant.

Mr. W. M. Carr (Stretford) remarked that some years ago he considered putting in an outside producer for the gasification of breeze, but at that time he had not found the Trefois. While he felt it might be done, he was nervous because he could not get guarantees, or else the regulations were too stringent. So he did not go ahead. The work that had been done in Manchester was most interesting. When breeze was fed to the producer, was any dust removed, or was

Mr. J. H. Sillitoe, General Manager and Secretary of the Manchester Gas Department (on right), and Councillor J. Williams, of the National Union of General and Municipal Workers. They are Joint Secretaries of the Lancashire Regional Gas Council.

the breeze, as it was screened from the coke—(say) from 1½ in. down—fed to the producer? If a percentage of the dust was removed, what was that percentage in relation to the total bulk of breeze? Many claims to gasify breeze had been made for producers in the past, but the interpretation of "breeze" was very wide. Some people would apply it to what were called coke nuts, which was a very useful fuel in domestic central heating stoves. He was speaking of ¾ in. to 1¼ in., or even 1½ in. To-day this had the fuel value of large coke. So really, when it came to net fuel economy, they were concerned primarily with that considerable percentage of breeze below ¾ in. The figures of efficiency in Table 2 were most interesting; with breeze the lowest gas efficiency was 67·5 p.ct.; with broken coke it was 88·5 p.ct. This was a matter for great congratulation to the designers; and also it indicated the efficient manner in which the plant must have been operated. Generally, had the experiments shown that the efficiency varied in proportion to the size of the fuel used? In Column E, 83·9 p.ct. was given as the efficiency with 50 p.ct. breeze and 50 p.ct. recovered coke (pan ash) breeze. He presumed the higher efficiency as compared with breeze alone was due to the better passage made for the blast, owing to the larger coke. He was sure everyone appreciated this valuable communication, and he looked forward with great interest to the results of the experiments which the authors had so kindly promised to contribute at a later date.

The President: If the dust is included in the breeze, how much of it is carried forward with the gas—that is to say, how much of the carbon content is lost?

Mr. G. Dixon (Lancaster) observed that, for feeding the breeze to the producer, there was a specially-designed distributor, something on the lines of a centrifugal machine. Was there any tendency to get stratification or a separation of the sizes of breeze, so that pockets of larger sizes and smaller sizes were formed, probably affecting the results? In connection with the same distributor, had it been found necessary to limit the percentage of moisture in the breeze? The grate with ball bearings was a mechanically interesting point which he had not seen before. Was any difficulty experienced with it? Ball bearings were a refinement in mechanical engineering; and he was wondering whether it was not too great a refinement to use it in such a process as a coke breeze producer. Could the members have the average horse-power necessary to drive the shaft of the moving grate? It seemed to him that, with the little slotted hoods on the bottom of the producer grate, there would be considerable resistance to the rotation. In regard to the fuel bed, of the 6 ft. only about 3 ft. was coke breeze; and this seemed to him a very thin bed. Was there any limit to the size of breeze that could be used? If it was too big, he supposed the fuel bed would be too thin. The outer grate was taking up 42·3 p.ct. of the total ash discharge per unit area, and the centre grate only 24·1 p.ct. Was there a tendency to get different depths of ash throughout the fuel bed? He was wondering whether in some parts of the fuel bed they were getting rid of more ash than in others. Had the authors considered what was the limit of size of gas-works to which such a producer could be applied?

Mr. Bloor said he believed that the determining factor in the Trefois producer was the deep bed of ash upon which the fire rested. At first sight it was a peculiar thing; it seemed to waste a large proportion of the valuable space created. But when he went into the matter before deciding upon the installation of such a producer, he came to the conclusion that this was the really characteristic thing in this invention, and without it the producer would fail to fill the special place it was hoped it would fill. He would like Mr. Holton to say a word on this point and tell him whether he was right or wrong.

Reply to the Discussion.

Mr. Holton then replied to the discussion. He pointed out that reference was made in the paper to a trial of very fine dust, which was noticeable particularly in the sizing of coal—*i.e.*, all that would pass through ⅜ in. The occurrence of channelling or blowholes was the only failure that had been encountered in regard to any kind of breeze on any occasion. This was a point which he wished to be clearly understood, because, as a matter of fact, pan ash breeze had actually been gasified. Of course, as they were all aware, even though pan ash breeze was washed there was always an amount of light clinker carried along with it. Experiments had been made recently with breeze from Durham coal, and every bit of it was below ¾ in.

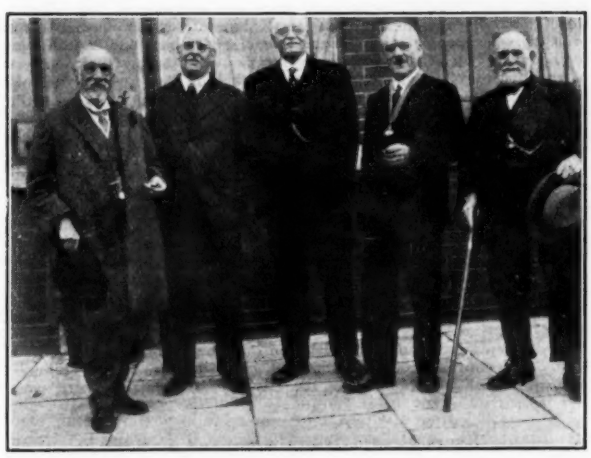
Reference had been made in the paper in regard to the height of the ash bed, which varied a little. It was possible to have a variation of approximately 18 in. between the centre and the outside. An attempt was made to keep it as level as possible, and the possibility of a further improvement had been considered by working the centre grate separately from the other two portions. The ash bed helped in regard to the distribution of the air. The members would be aware of the existence of conical grates, in which there was no equal depth of fuel. An ideal bed would secure an equal passage for the air at all points, the ash bed acting as an equalizing medium for the air.

No trouble whatever had been experienced in regard to moisture. He did not know that any sample had been tried with over 25 p.ct. moisture—which, he thought, would be agreed was sufficiently wet.

The ball bearings of the producer were not a refined mechanical job; in fact, it was somewhat of a misnomer to describe them as ball bearings, as they were merely cast-iron balls of the crudest description. There had been no trouble with the producer during the five years it had been working. The only repairs to the producer during that period were the replacing of the casing at the top, for which a separate price was taken out in the costings, and the renewal of two spare wheels.

Many attempts had been made to eliminate tar troubles. The use of anthracene oil had been found to be the most suitable for the purpose. All kinds of solvents had been tried. Owing to the very satisfactory results obtained by the use of anthracene oil, the electrical method for the precipitation of tar had not appealed to the authors of the paper. The anthracene oil went back again into the tar, and its cost was negligible. No trouble whatever had been experienced from fine dust.

There had been no noticeable difficulty in regard to the stratification of the breeze due to the fuel bed. As far as Bradford Road was concerned, no dust was removed. The breeze was taken exactly as produced. In the case of the horizontal retort house and the vertical retort house—the remark applied to all the works now—all coke was screened through a 1-in. screen, and everything below that was termed breeze. A very fine dust had been taken out of about ⅛ in.



Reference had been made in the discussion to the fact that when No. 2 sized coke was used there was an efficiency of 88 p.ct. The authors of the paper would not dream of using that fuel, because of its market value. It was only a matter of test. As far as the costs were concerned, they had been taken out on a basis of 120 tons per day. There was a saving on every ton of coal carbonized at that size. There were smaller producers made.

The main point was the breeze problem. Some works to-day found that their breeze was accumulating and that they had no outlet for it. Instead of the 5s. put down on the suggested cost they would be very pleased to receive half the amount. His colleague and himself hoped that in all cases where there was a breeze problem the information presented in the paper would prove to be of real service.

Regarding the power used for the plant, at Bradford Road it was 20 units of electricity per ton of fuel, and at Partington it was 30.

Vote of Thanks.

Mr. Dixon proposed that a hearty vote of thanks be accorded to Mr. Holton and Mr. Applebee for their paper. What appealed most to himself in regard to it was the fact that it mentioned several points with which he was not in agreement; and, to his mind, this was a most valuable aspect of any paper. It was obvious that a great deal of very hard work had been entailed in the preparation of the paper, and the manner in which it had been presented in abstract was excellent.

Mr. H. R. S. Williams (Altrincham Gas Company) seconded the vote. He thought the members of the Institution owed a debt of gratitude to the authors of the paper for the way in which they had outlined their difficulties and their successes.

Mr. Applebee, responding, said that in regard to himself the preparation of the paper had certainly had one beneficial effect in that he had given deeper thought to some of the matters which had arisen than he had formerly done. When busily engaged at work one was rather apt to take things for granted, and it was well worth while to sit down and critically consider one's own work.

Mr. Holton said he was very pleased to be able to respond to the vote of thanks in the presence of the Chairman of the Manchester Corporation Gas Committee and of many of their members. His reason for this was because he wished it to be known that the Manchester Gas Committee had been anxious at all times that any information which would be of benefit to the industry should be imparted to it as far as it lay within their power to be of any service. In regard to the inspection of experimental work, of plant, and of trials on the plant, at all times he had always found that the Chairman and the Committee were only too willing that the fullest opportunity for gaining information should be accorded to the representatives of any gas undertakings who desired it.

Ald. John Harrison (Chairman of the Manchester Corporation Gas Committee) remarked that the industry was now looking forward to the young men entering it to extend its sphere of usefulness and raise its technical efficiency to greater heights.

Luncheon.

The members were then entertained at luncheon by the Manchester Corporation Gas Committee—Alderman John Harrison presiding.

Alderman Sir William Kay, J.P. (Chairman of the Partington Works Sub-Committee), proposed the toast of "The Manchester District Institution of Gas Engineers." He said that one of the pleasing points in connection with the toast, from his point of view, was that the visit to the Partington Works coincided with the year in which the Institution had celebrated its Jubilee. He felt that the functioning of the Partington Works represented the beginning of a new era in the gas industry. The conditions relating to the gas industry had changed enormously since the inception of the Institution. At that time the industry stood alone—to-day it was an elder brother, some people might say it was a godfather, but at any rate it had a very healthy associate in electricity. Possibly the members of the Institution would not disagree with him very much if he told them that their duty was not so much the making of gas as the selling of it. Nevertheless, there was not the slightest need to dread the presence of their so-called competitor, because there were two distinct fields of enterprise for two distinct commodities.

There was one matter upon which he would like to touch. It could be said, without fear of contradiction, that the gas industry had come out better than any other in regard to its treatment of labour and in the way in which the directors of undertakings and the workers they employed had come to bases of agreement one with the other. No industry could be more fortunate than in the easy and sensible way in which the labour problems had been approached and settled. It was now the best organized industry in the country, and the Manchester District Institution of Gas Engineers had contributed its full share of support in bringing about this happy consummation. All conscientious employers were interested in bringing about a happy and comfortable understanding between capital and labour—and quite rightly so. Taking the case of Manchester, there were 223,000 consumers of gas. This implied that 223,000 people were interested in the progress and welfare of the Manchester Undertaking, and would welcome any legitimate means which would provide a cheap and efficient service for the citizens. It should not be forgotten—and there was some risk of its being the case—that it was owing to the efforts of the members of such Institutions as theirs that the country was enabled to enjoy a sufficient supply of gas during the dark days of the war, besides supporting and assisting the Allies in a time of great stress.

Nowadays, no one in this country need be without an economical, efficient, and adequate heat supply in their business places or homes. He thought the term heat supply was the correct one to use; it seemed to him better than gas supply. There was no need now for the coal cart to trundle down the street, and if full advantage was taken of the heat supply from the gas undertaking, there would be much less need for the refuse cart. In days gone by he used to speak about the supply of gas at 1s. per 1000 c.ft. If all the devices of modern science were exploited, this most desirable state of things might yet ensue.

Mr. W. J. Smith (President of the Institution), in responding to the toast, remarked that the Institution was founded with a view to the interchange of thought among its members, and that a visit to such a works as Partington was bound to be helpful and stimulating. They were all interested in bringing the cost of gas down to the lowest possible economic level, and when Sir William Kay had succeeded in giving a supply at 1s. per 1000 c.ft. they would all sincerely hope that he would receive a good profit as well.

He would further like to state that the gas engineers of Lancashire owed a great debt of gratitude to Mr. J. H. Sillitoe, the Secretary of their Regional Council, for the extremely able manner in which he fulfilled his duties. He was a gentleman of exceedingly great tact, and his point of view was always worthy of the most serious consideration.

Unfortunately, the gas industry was still badly handicapped by various Acts of Parliament embodying restrictions which were useful neither to the producer nor to the consumer. The time had come when the industry should have more freedom of action, similar to that enjoyed by electrical undertakings.

The Manchester Gas Undertaking.

Mr. R. E. Gibson, M.Inst.C.E. (Engineer, Liverpool Gas Company, and Junior Vice-President of the Institution of Gas Engineers), in proposing the toast of "The Manchester Gas Undertaking," said that he desired to congratulate the Manchester Corporation upon its courage and foresight in erecting the Partington Works, and thus providing for the future requirements of Manchester as regards gas. He was one of those who believed in the future of gas, although conditions were now very different from what they were twenty or thirty years ago, when gas practically sold itself. As Sir William Kay had pointed out, the sales side of the industry would have to be developed. The industry had good commodities to sell; and, with good salesmanship, the results were bound to be profitable. The handicap of antiquated legislation must be removed. They had been told that, owing to the operation of the new Coal Mines Act, coal would be dearer. But, given a fair field and no favour, he was convinced that the industry would forge ahead rapidly. Even with all its present handicaps it was putting up an extremely good fight.

Alderman J. Harrison (Chairman of the Manchester Corporation Gas Committee), in responding to the toast, expressed the pleasure the Committee felt in being able to invite the members of the Institution to visit the Partington Works. His great hope was that all who had seen them would be able to glean some useful information from the way the works were conducted.

Councillor J. Williams, representing the National Union of General and Municipal Workers, also responded to the toast, and cordially endorsed the remarks which had been made respecting the friendly relationship which existed between gas undertakers and their employees. As regards present-day conditions for the working-classes, the times were almost revolutionary compared with what they were forty years ago. He did not think he could name a single gas engineer who could be regarded as an opponent of real labour organization. Mr. Sillitoe and himself were the Joint Secretaries for the Lancashire Regional Gas Council, and they had always been able to work together in the most harmonious manner. It would not now be inaccurate to state that all those concerned in the gas industry were now a happy family and very largely personal friends. He also wished to emphasize the necessity for removing unreasonable handicaps so far as the law of the country was concerned. Many of the stumbling-blocks were now half-a-century old, and it was time that something was done to improve the position. Personally, he had no use for "dismal Jimmies;" in his opinion the outlook for the industry was as bright as, if not brighter than, it had ever been before.

Eastern Counties Gas Managers' Association

SOME PROBLEMS AND SUGGESTIONS RELATING TO COAL TAR

By W. J. Chadder and H. M. Spiers, M.A., B.Sc., F.I.C., of the Woodall-Duckham Companies.

[Presented at the Meeting in London to-day.]

The effect which tar has on the balance-sheet of a gas undertaking is sufficiently great to justify the devotion of careful thought to the subject. A fluctuation of one penny per gallon in the selling price of the tar is equivalent to a fluctuation of rather less than one penny in the cost of production of 1000 c.ft. of gas. In spite of its value from the point of view of revenue, tar is too often looked upon as a nuisance, and receives but little attention. Neglect, however, merely increases the nuisance and prevents the realization of the maximum return which can be obtained from this important bye-product. Crude tar is a product very difficult to sell except under contract. Refined tars, however, find a ready market.

Differences in the Nature of Tar.

Coal tar is very variable in its nature and composition. The major variations are due to differences in the carbonizing conditions, and there is a decided trend in the various properties in the sequence horizontal retort tar, coke oven tar, intermittent chamber tar, vertical retort tar, and low-temperature tar. The trend may best be illustrated by reference to two very extreme cases.

Properties of Two Widely Different Tars.

—	Horizontal Retort Tar. High Carbonizing Temperature. Lightly Filled Retorts.		Low-Temperature Tar.	
Specific gravity of the dry tar	1·24		1·03	
	P.Ct. by Weight.	Sp. Gr.	P.Ct. by Weight.	Sp. Gr.
Distillation of the dry tar—				
To 170° C.	1	0·90	4	0·83
170–200°	2	0·95	6	0·88
200–230°	6	1·01	12	0·94
230–270°	10	1·04	15	0·98
270–300°	4	1·06	10	1·00
300°–medium pitch	10	1·11	18	1·03
Medium pitch	67		35	
Crude tar acids in 170–270° C. fraction—				
P.ct. by volume of fraction	12		45	
P.ct. by volume on the dry tar	2½		16	
Naphthalene in 170–270° C. fraction (as estimated by the method used in road tar analysis)—				
P.ct. by weight on the dry tar	7		*Nil*	
Free carbon, p.ct. by weight	28		1	

The general tendency along the series is a decrease in the specific gravity of the tar and of corresponding distillates, a decrease in the free carbon content and naphthalene content, a decrease in the pitch content, an increase in the tar acid content, and an increase in the content of the medium boiling and high boiling oils.

As the temperature of carbonization increases, progressively more decomposition of the tar occurs. This manifests itself in the appearance of the aromatic hydrocarbons characteristic of high-temperature tars and in a simplification of the structure of many of the other constituents due to demethylation. In this way the higher tar acids and bases by successive replacement of methyl groups by hydrogen are converted into the simpler phenols and pyridine bases. De-oxygenation also occurs with formation of hydrocarbons from oxygenated compounds. The natural result of these changes is reflected in the yields of tar from coal carbonized in the various types of plant.

Each particular system of carbonization produces a characteristic tar, as is illustrated by the Tables 1-19 of the Appendix. However, the tars produced by any one system of carbonization differ considerably among themselves, though they may be recognized as conforming to a type. Numerous factors contribute to these variations in the nature of the tars arising from a particular system. Moreover, any factor which affects the nature of the tar will affect the yield also.

A quantitative study of some of the factors involved has been made by several investigators, the most recent publication being a Technical Paper just issued by the Fuel Research Station and entitled "The Influence of Size of Coal During Gas Manufacture." The investigation was more comprehensive than the title suggests, since it covered three different coals and two systems of carbonization. There is given, also, a useful historical survey of the work of earlier investigators.

Factors influencing the yield and/or nature of the tar produced in a given type of carbonization plant include:

(1) The nature of the coal.
(2) The grading of the coal.
(3) The moisture content of the coal.
(4) The ash content of the coal and the nature of the ash.
(5) The combustion chamber temperature.
(6) The free space in the retorts.
(7) The pull on the retorts.
(8) Infiltration of air into the retorts.
(9) The condition of the retorts as regards scurf.
(10) The dimensions of the retorts.
(11) The throughput of the retorts.
(12) The degree of steaming.
(13) The temperature zoning.

The effect of variations in the nature and grading of the coal and in the carbonizing system is shown in the following table prepared from the data contained in the above paper.

Gallons of Dry Tar per Ton of Dry Ash Free Fuel.

Horizontal Retorts.			Coal and Caking Index.	Glover-West Vertical Retorts.		
Large Coal.	Medium Coal.	Small Coal.		Large Coal.	Medium Coal.	Small Coal.
13·0	10·9	11·7	Mitchell Main (24)	16·2	12·3	11·1
14·3	12·5	11·8	Dalton Main (14)	19·5	13·9	13·1
15·3	13·8	11·6	Shafton (12)	22·6	17·2	14·4

As regards the coals studied, Mitchell Main is a highly caking coal, Dalton Main a coal of medium caking quality, and Shafton a coal of lower caking quality than Dalton Main.

It will be noted that, under the particular conditions studied, coal size is of much greater importance in vertical retorts than in horizontal retorts. In vertical retorts, irrespective of the type of coal, the tar yield was roughly 50 p.ct. greater in the case of large coal than with small coal. In horizontal retorts, the increase in tar yield resulting from the use of large coal was most pronounced in the case of the feebly caking coal (32 p.ct. increase), whereas in the case of the strongly caking coal it was only 11 p.ct.

It has, of course, long been known that the tar yield with vertical retorts is considerably higher than with horizontal retorts, but it has probably not been realized before that with a highly caking coal of small size the tar yield may be higher in the case of horizontal retorts than with vertical retorts. This would certainly seem to be the case according to the figures quoted, but possibly experimental errors have been responsible for this unexpected result.

Consideration of the factors which have been indicated as affecting the nature and yield of the tar shows that some are controllable without adverse effect on the efficiency of the carbonizing plant. Such control should be exercised rigidly in order to regularize as far as possible the output of tar from any particular installation. In the case of some of the other factors, conditions must be chosen with due regard to the economics of gas manufacture as a whole, and the tar must be largely left to look after itself.

It will often be justifiable, therefore, to sacrifice tar yield in order to obtain a higher therm yield.

In the case of horizontal retorts, however, excessive cracking

of the tar should be avoided, otherwise the tar will have too high a specific gravity and will be excessively rich in naphthalene and in free carbon. Carbonization of full charges, as is well known, gives rise to a much more useful tar than does carbonization of light charges.

Tar Handling.

As regards the collection, handling, and disposal of tar, the gas engineer has more scope than in the actual production of the tar. Much can be done as regards tar collection to obviate troubles which might otherwise be encountered in the subsequent working-up of the tar.

Two tables are given which illustrate some of the characteristics of the tar deposited at various points on two plants.

Coke Oven Tar.

Distillation of Dry Tar.

—	Tar *ex* Collecting Mains.	Tar *ex* Hot End of Indirect Water Coolers.		Tar *ex* Outlet of Indirect Water Coolers.	
Sp. Gr.	1·197	1·176		1·050	
	P.Ct. by Weight.	P.Ct.	Sp. Gr.	P.Ct.	Sp. Gr.
To 200° C.	3·2	1·5		16·4	0·957
200–230°	1·5	8·9	1·03	38·5	0·989
230–270°	5·5	14·6	1·040	12·5	1·008
270–300°	3·3	6·1	1·064	4·0	
300–350°	12·5	10·1	1·101	5·3	
Pitch at 350°	73·5	58·3		22·9	
Free carbon	..	3·5		2·2	
Consistency	100 secs. at 40° C.	5 secs. at 30° C.		Very fluid at 30° C.	
Crude tar acids 200–270° C. fraction	..	5·4 p.ct. vol. on dry tar		..	
Naphthalene	..	7½ p.ct. by weight		20–25 p.ct. by weight	

The introduction of liquor spraying has been of inestimable value in serving to keep the foul main free from pitchy deposits, since the shock cooling thereby achieved results in the simultaneous deposition of the lighter as well as the heavier constituents of the tar. For smooth working it is necessary to secure that clean liquor is used in the sprays to prevent their becoming clogged. Excessive re-circulation of the liquor should be avoided, and the concentration of fixed ammonia salts in the liquor should not be allowed to become so high that the separation of the tar and liquor is adversely affected. It is not good practice to supply the sprays merely from the drainings of the foul main, but, on the contrary, the condenser runnings should also be employed. When this is done, there will be a constant surplus in the liquor feed tank, and the surplus can be passed to the liquor storage tanks. By this means it is readily possible to avoid over-concentration of the liquor.

The storage of tar and liquor together causes many troubles. In many gas-works the tar and liquor gravitate from a number of points to a common storage well. This practice certainly avoids the use of pumps, but difficulties may be encountered through formation of emulsions and the production of troublesome effluents from the ammonia stills. Especially in the case of vertical retort installations where the tar from the foul main and the tar separated in the condensers are permitted to flow separately into the storage wells, three layers are often formed, due to the condenser tar being lighter than the liquor. This can usually be overcome by joining all the streams of tar into a common outfall which discharges at one point into the well. Improvements can be effected by separating the tar and liquor as soon as is possible, and by storing tar and liquor separately; and this is to be recommended even though gravity flow is then not feasible and pumps must be used for the drips.

It is advantageous to separate the tar and liquor while they are hot, since separation is then more rapid and complete. The formation of troublesome emulsions may be due to the presence in the tar of an excessive amount of free carbon. Much can be done to avoid the formation in horizontal retorts of tars having an abnormal content of free carbon. This is achieved by the carbonization of full charges and working the retorts under level gauge conditions, since excessive decomposition occurs when the retorts are but partly filled, and this is especially the case when combustion chamber temperatures are high.

Where turbo-exhausters are in use, it is found that tar is freely deposited from the gas in its passage through the exhausters, due to the centrifugal force created. It has been proposed, on the Continent, to dispense with tar extractors after such exhausters, but it is doubtful whether this is satisfactory under all conditions. Livesey and other types of direct washers are useful in that they serve to remove the last traces of tar fog from the gas.

To obtain the best results, tar extractors of the ordinary static type require to be used at a temperature slightly above that of the atmosphere. Electrostatic tar separators can, however, work on hot gas. They have been adopted to some extent in America and the Continent, and some installations are already in operation in this country. Electrostatic tar separation is efficient, but a higher capital charge has to be met. Electrostatic separation is particularly useful where the direct process of ammonia recovery is practised, since, as has been stated, complete cooling of the gas is unnecessary. Electrostatic separators have a great advantage in that they create practically no back pressure.

Tar Disposal.

Alternative methods of tar disposal available at gas-works are the sale of crude tar to distillers under contract or through a co-operative system, or the sale of refined tar or road tar. It is in most cases an advantage to the undertaking from the point of view of increased revenue to instal plant for the manufacture of road tar, since it is generally possible to dispose of all the treated tar locally for use on the roads. There is a sufficient margin between the selling price of crude tar and of refined tar *plus* distillates to show a handsome profit to an undertaking supplied with its own tar treatment plant. Modern tar distillation plant has been rendered very simple to operate, and but little supervision is required. The chief consideration to be borne in mind is that the road tar produced should be of uniform quality and up to the standard required by the purchaser. In some cases it happens that some of the gas-works in a particular area may be producing tar which is not readily convertible into road tar complying with the standard specification. Such difficulties are encountered not only with vertical retort tars but also with horizontal retort and coke oven tars, since,

Vertical Retort Tar.

All Percentages by Weight.	Heavy Tar Condensed in Retort House.	Light Tar Outlet Condenser.		Deposit from Tar Extractor.		Light Tar Deposited from Gas between Tar Extractor and Purifier.		Light Tar from Syphon on the District.	
Total liquor	44·6 p.ct.	41·1 p.ct.		54·1 p.ct.		70·1 p.ct.		4·1 p.ct.	
Total dry tar or oil	55·4 ,,	58·9 ,,		45·9 ,,		29·9 ,,		95·9 ,,	
Sp. gr. at 60° Fahr. of dry tar or oil	1·142	1·070		1·171		0·954		0·922	
Dry tar or oil distillation—			Sp. Gr.		Sp. Gr.		Sp. Gr.		Sp. Gr.
Oils to 170° C.	*Nil*	4·3 p.ct.	0·860	1·2 p.ct.	0·968	2·3 p.ct.		8·9 p.ct.	0·840
170–230°	6·6 p.ct.	18·9 ,,	0·930	18·7 ,,		44·4 ,,	0·906	68·1 ,,	0·887
230–270°	12·5 ,,	10·2 ,,	0·994			20·0 ,,	0·940	6·3 ,,	0·933
270–300°	7·9 ,,	5·9 ,,	1·014	6·2 ,,		4·9 ,,		3·0 ,,	0·966
Residue at 300° C.	72·1 ,,	60·5 ,,		72·8 ,,		24·4 ,,		11·8 ,,	
Loss	0·9 ,,	0·2 ,,		1·1 ,,		4·0 ,,		1·9 ,,	
Free carbon on dry tar (gross)	9·5 ,,	5·0 p.ct.		15·0 p.ct.		..		..	
Nature of distillation residue	Very soft ductile pitch	Very soft ductile pitch		Soft pitch, but brittle		Brittle pitch, twisting pt. approx. 50–55° C.		..	
Remarks	..	..		..		Very low in tar acids. Naphthalene present.		Tar acids absent. Naphthalene present.	

though vertical retort tars may sometimes be too low in specific gravity and free carbon content, horizontal retort and coke oven tars are sometimes too high in specific gravity, in content of free carbon, and in naphthalene. It should therefore often prove advantageous for several undertakings to co-operate in the installation of a central tar distillation plant which, if need be, could be situated at one of the works in the district, and would treat the blended tars available from the works of the co-operators.

A uniform road tar suitable to all the requirements of the particular district could thus be readily assured, and markets which are now only open to imported petroleum bitumen could be re-opened to tar. What success bitumen has achieved is certainly not due to its superiority over properly prepared tar as a material for road construction. It has largely come about as a result of intensive advertisement, a lively interest in the material on the part of producers and distributors, and the striving after a uniform product. This question of uniformity of the road material is the crux of the situation, and the industry at large is urged to direct its attention to it.

The marketing of the tar should present no difficulty to the gas undertakings. They have already largely achieved the successful disposal of another bye-product—namely, coke—by marketing it in suitable forms and by advertising its advantages, and there should be no diffidence in dealing similarly with road tar.

A round-table conference with the local surveyors will generally enable a decision to be reached as to the most suitable tar from the point of view of local traffic conditions, and every endeavour should then be made to secure that deliveries are always up to these requirements. The supply of hot road tar in tank wagons may often prove advantageous both to the undertaking and to the road constructors, for on the one hand the expense of barrelling is avoided and on the other hand the need for tar boilers is eliminated. A further possibility is for the gas-works to undertake the actual surfacing itself, under contract.

Adaptability of the Various Types of Tar to Manufacturing Processes.

Due to their essentially aromatic nature, the true high-temperature tars must always serve as the source of the preparation of the pure hydrocarbons used in the manufacture of dyestuffs, synthetic chemicals, and explosives. These hydrocarbons are, however, required in comparatively small quantities, and there will doubtless always be sufficient high-temperature tar available to meet the market requirements. Nowadays, the largest individual consumer of tar is the road industry. During the present century, there has been a rapid increase in the annual output of road tar, a rapid decrease in the output of horizontal retort tar, and a rapid increase in the annual output of vertical retort tar. Indeed, though it is only since 1903 that vertical retort tar has been available, at the present time at least 65 p.ct. of the tar produced in the gas-works of Great Britain is derived from the carbonization of coal in vertical retorts. The geographical distribution of the centres of tar production is such that it is desirable from an economic point of view that large quantities of vertical retort tar should be converted into road tar. The question then arises as to whether vertical retort tar is suitable for this purpose.

Suitability of Various Tars for Road Making Purposes.

The pioneer work in the construction of tarred roads was carried out with horizontal retort tars, and it is a fact that the vast majority of crude horizontal retort tars is readily convertible into satisfactory road tar. Many millions of gallons of vertical retort tar have also been converted into road tar which has been used with equally satisfactory results. Modern traffic requires, however, a tar of higher consistency than sufficed even a few years ago, and, at the same time, the necessity is still present that roads must be able to be opened up to traffic within a few hours of treatment. In the case of vertical retort tars, a high consistency is generally obtainable only by the removal of a higher proportion of distillates than in the case of horizontal retort tars, and the consequence is that by the time the desired consistency is reached, all the readily evaporable oils have been removed. The result is that the road tar dries at a slow rate, and durable roads have in some cases not been realized on this account. In many instances this has been remedied by the use of a tar of even higher consistency than is required by the specification, reliance being then placed on a setting due to cooling rather than on a setting due to evaporation. Recently, however, a simple method of securing both high consistency and high rate of drying in the case of vertical retort road tars has been developed, and this will be described later.

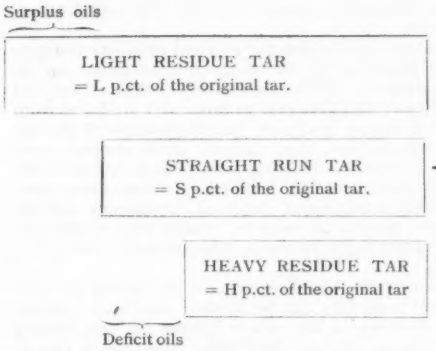
We are far from knowing what are the essentially valuable physical properties of tars from the point of view of the road industry, particularly as regards assigning numerical limits to these properties for specification purposes. Ductility, penetration, cementitiousness, and durability and resistance to oxidizing conditions, actinic rays, and extremes of temperature are all of importance. In some cases, satisfactory standard methods for the measurement of the property concerned are not available; in other cases, though methods are available, sufficient knowledge has not been gained to enable the tests to be incorporated into testing specifications. The existing specifications for road tar are therefore based on tests which are quite unconnected with the real properties involved. Consequently, the specifications work rather on a "hit and miss" principle, and, while ensuring that products complying with the specification may reasonably be expected to give good service on the roads, yet at the same time exclude much good material. This will, in course of time, be rectified when, as a result of the introduction of new methods for the testing of tar, it becomes possible to draw up the specifications on sound scientific lines.

Blending of Light and Heavy Residue Tars.

The distillation characteristics of tars as well as other properties can be modified by the blending of light residue tars with heavy residue tars.* It is thus possible to prepare from a given tar a series of road tars having the same consistency but differing widely in their distillation characteristics. This is naturally of importance in connection with the control of the drying properties of road tar and is of especial importance in connection with vertical retort tars.

The following diagram explains the principles involved:

Diagrammatic Illustration of Blending Process.


Surplus oils
LIGHT RESIDUE TAR
= L p.ct. of the original tar.
STRAIGHT RUN TAR
= S p.ct. of the original tar.
Consistency = X secs.
HEAVY RESIDUE TAR
= H p.ct. of the original tar
Deficit oils

Let it be assumed that a straight-run residue tar representing S p.ct. by weight of the original dry tar has the desired consistency of X seconds.

A lightly topped tar representing L p.ct. of the original tar will have a surplus of low-boiling oils compared with the straight-run tar, the surplus of low-boiling oils amounting to L−S.

A heavily topped tar representing H p.ct. of the original tar will have a deficiency of high-boiling oils compared with the straight-run tar, the deficiency of high-boiling oils amounting to S−H.

If the lightly topped and heavily topped tars are blended in suitable proportions, the consistency, X seconds, of the straight-run tar can be matched.

Blending Proportions.

The relationship is such that to each part by weight of the light tar there must be added—

$$\frac{H\ (L - S)}{L\ (S - H)} \times \frac{M_L}{M_H}$$

parts by weight of the heavy tar. M_L and M_H represent the oiling back constants of the surplus low-boiling oils and the deficient high-boiling oils respectively.

It is possible to take an overall value of $\frac{M_L}{M_H}$ in the calculation. This value may be found by experiment for each particular tar, but may often be taken as 2·0 for light and heavy tars produced rapidly in continuous stills, or as 1·5 for the tars produced slowly in intermittent stills.

For a particular tar, the overall value of the ratio $\frac{M_L}{M_H}$ is influenced to some extent by the values of H and L.

The high ratio associated with rapid distillation is due to the phenomenon of primary consistency. [Condrup and Spiers, "Gas Journal," 1929, **186**, 856.]

If a very hard pitch be used as the heavy component, the overall value of the ratio may be as high as 4-5. Hence it is possible to obtain a large increase in specific gravity and free carbon content by making use of a heavy component of this nature. The blending process is thus very flexible.

The net effect of the blending operation is that in comparison

* Patent applied for.

with the straight-run road tar some heavy oils have been excluded and have been replaced by lighter oils. Since the lighter oils have a greater effect on consistency than have the heavier oils, weight for weight, the lighter oils introduced are less in amount than the heavy oils excluded, hence the yield of road tar is somewhat less than is obtained by the straight-run distillation.

Obviously, the properties of the blend may be varied at will by arbitrary variations in the values of L and H, and at the same time the blending ratio for the production of a tar of the desired consistency varies, in accordance with the above formula. If, however, the distillation characteristics of the tar are known, it becomes possible to calculate fairly closely what will be the distillation characteristics of each particular blend. If a series of values of L and H be chosen, the corresponding blending ratios for the desired consistency may be calculated for each pair of residues and the distillation characteristics, tar acid content, free carbon content, and so on may then be deduced, approximately, for each blend. The particular blend which has the most suitable characteristics may then be selected, and it is then possible to prepare the two components required and to blend them in the necessary proportions. Uncontrolled blending is useless.

Since the yield of road tar, by the blending process, is less than it is in the case of straight-run distillation, the road tar will have a higher concentration of pitch, and hence the free carbon content and specific gravity will be higher than would ordinarily be the case. This is of importance since the blending process thus often enables compliance with the British Standard Specification to be obtained in cases in which this would otherwise not be achieved.

As regards enabling a particular tar to yield products complying with the specification, the blending process must not be looked upon as a panacea. What we can say is that all vertical retort tars treated by it will give rise to improved products from the point of view of drying qualities, but the nature of the tar as regards tar acid content, free carbon, pitch content, and other constituents will be the deciding factors as to whether the specification requirements can be fulfilled. It sometimes happens that only within a particular range of consistency can the specification be met, thus a tar may be readily convertible into a 60 seconds tar complying with the specification but not into a 30 seconds tar.

The useful feature of the blending process as applied to vertical retort tar is that road tars can be thereby produced containing a significant content of the whole gamut of oils boiling above 200° C., whereas straight distillation often gives rise to products showing complete absence of oils coming over below 230° C. or even absence of oils coming over below a still higher temperature.

We have been greatly assisted in the development of the new blending process by the kind co-operation of Mr. Green and of Mr. Troughton, who enabled us to follow up the results obtained in our laboratories by large-scale trials at their works.

An example of a road tar made by this method, exclusively from vertical retort tar, at the Newmarket Gas-Works is shown in the following table:

Specific gravity at 60° Fahr.	1·15
Water	trace
Oils to 200° C.	0·4 p.ct. by wt.
200–230°	3·4 ,, ,, ,,
230–270°	6·8 ,, ,, ,,
270–300°	6·2 ,, ,, ,,
Residue at 300° C. and loss	83·2 ,, ,, ,,
Tar acids	3·5 ,, ,, vol.
Free carbon	6·7 ,, ,, wt.
Consistency B.R.T.A. at 86° Fahr.	20 secs.

It will be observed that this tar complies in every respect with the British Standard Specification for a No. 1 Tar. The same result could not have been achieved by a single straight-run distillation.

In the case of tars which do not lend themselves to compliance with the specification, as a result of the blending process outlined above, blending with a tar of different type is an alternative.

Effect of "Oiling Back" on the Consistency of Road Tars.

At the Tar Conference held in Manchester in 1926, one of us read a paper dealing with the variation of the Hutchinson consistency of tars with temperature over small intervals of temperature. During the course of the discussion it was suggested that an investigation of the quantitative effect of oiling back on the consistency of road tars would be useful. Work on these lines has now been carried out by Mr. C. O. Condrup in the Woodall-Duckham laboratories, but the results have, so far, not been published. It has been found that the effect of addition of oils can be represented with very fair accuracy by means of the formula:—

$$\log \log 10C - \log \log 10C_1 = M \times \frac{O}{T}$$

Where C is the consistency (Hutchinson at 77° Fahr.) of the original tar in seconds
C_1 is the consistency of the oiled back tar in seconds
O is the weight of oil added to
T, the weight of original tar expressed in similar units
—*i.e.*, $\frac{O}{T}$ is the weight of oil added to 1 part by weight of the original tar
M is the oiling back constant of the particular oil used.

M may be as low as 1·0 for a heavy distillate from vertical retort tar and may reach a value as high as 2·7 for a decarbolated light oil. It may vary between approximately 2·0 and 2·3 in the case of vertical retort tar distillates having a consistency of about 5 centipoises and a boiling range of 210/240° C.

Typical values of "M" are as follows:

Oiling Back Constants.

Nature of Oil.	Viscosity at 25° C. Centipoises.	M.
Dehydrated tar	?	0·3
Filtered anthracene oil	47·1	0·8
Heavy neutral vertical retort tar oils	10·9	1·43
Vertical retort tar creosote 240/300° C.	7·5	1·90
Decarbolated distillates from vertical retort tar 260/290° C.	5·0	2·10
Distillates from vertical retort tar 210/240° C.	4·72	2·14
Decarbolated toppings from vertical retort tar 200/210° C.	1·51	2·68

Few horizontal retort tar distillates have been examined from this point of view. The few observations which have been made indicate that for vertical and horizontal retort tar distillates having the same viscosity, the vertical retort tar distillate has the higher value for "M" and is hence the more effective in reducing the consistency.

Neutral oils appear to be less effective in reducing the consistency than do mixed distillates of similar viscosity; but since the presence of tar acids raises the viscosity, the boiling ranges are quite different.

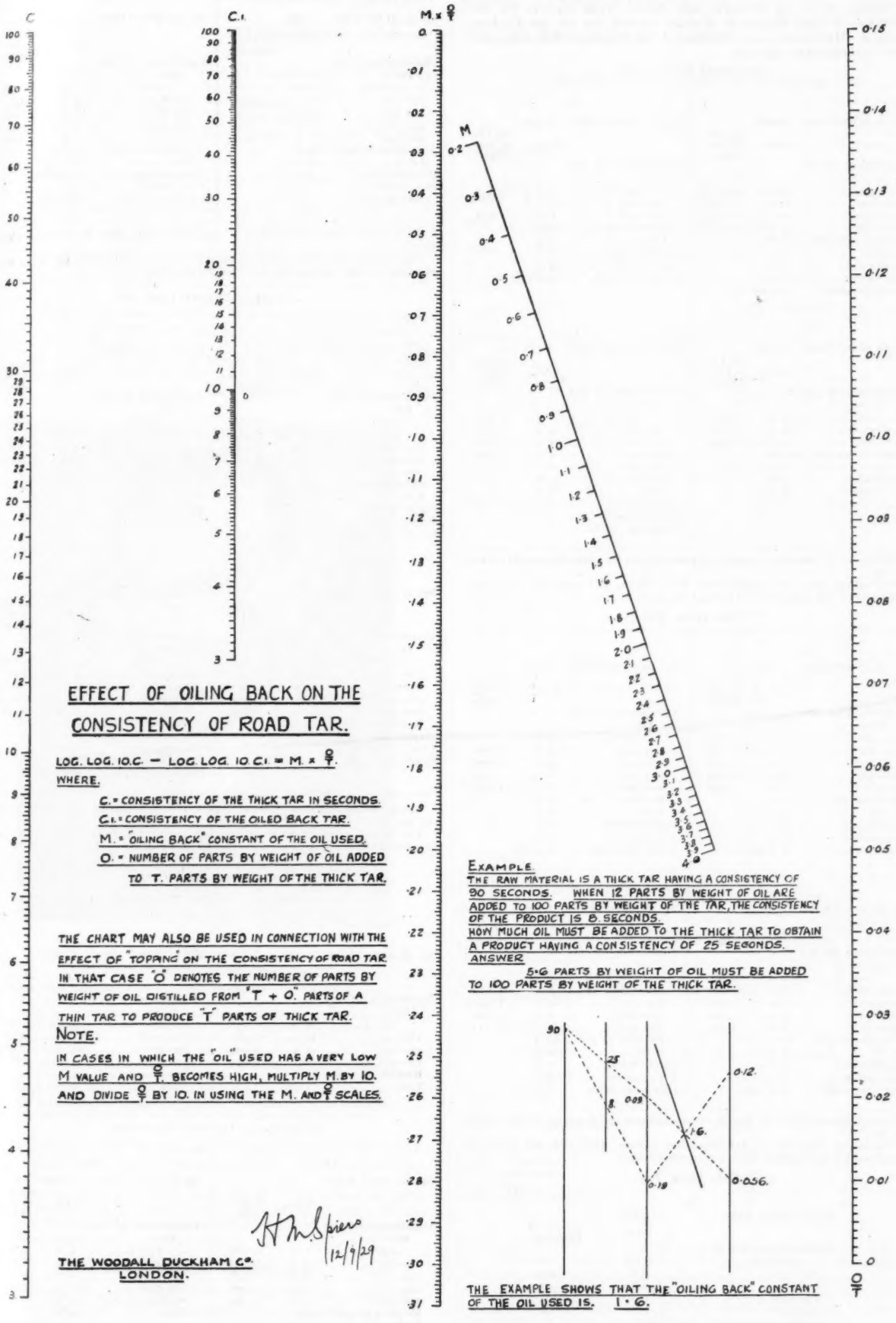
Insufficient data are available to enable the oiling back constant of a particular oil to be precisely predicted; but if the consistencies of a tar and of one mixture of the tar with a known addition of oil be determined, the value of the constant is obtainable from the formula and the consistency of mixtures of other compositions may then be calculated. A nomogram has been constructed to enable the results to be obtained without calculation. The formula is applicable, also, in the case of "topping." In this case, in the fraction $\frac{O}{T}$, O represents the weight of oil which is distilled from T + O parts of the tar to produce T parts by weight of topped tar.

New Methods for Tar Treatment.

Much work has been done in connection with processes intended to modify the nature of tar or of the products obtainable from it. The wonderful success achieved by cracking in the petroleum industry has led to the hope that such processes might be successfully adopted in the tar industry, not necessarily with a view to a very profound degree of cracking, but possibly merely in order to effect an incipient cracking resulting in a comparatively slight modification in the nature of the tar. Cracking of tar is, however, not as easy as is the case with petroleum cracking, but many of the difficulties have been overcome, and full-sized plants are in operation, though with what degree of success is not known. Chemical treatment of tar has also received consideration with the same end in view, and on the one hand treatment with sulphur and on the other with formaldehyde condensation products followed by air blowing have been proposed. A further suggestion has included the incorporation of finely powdered coal into the tar under the influence of heat. Treatment by suitable means may have important effects in controlling the viscosity-temperature relationship of road tars, and this may be of use in tropical or in very cold climates. A further development which enables road surfacing work to be carried out under unfavourable weather conditions has been the introduction of tar emulsions.

The subject of filled tars has not been adequately explored, but seems worthy of attention with a view to a study of the pros and cons of the matter. It is, perhaps, not unreasonable to hold the view that additions of material foreign to the nature of the tar will have the effect of lowering the quality of the product rather than of enhancing it; but this may not apply universally, and a satisfactory filling material may be developed. In this connection, bitumen addition stands in a class apart, since it cannot strictly be regarded as a filler.

The authors desire to express their thanks to the Directors of the Woodall-Duckham Companies for their permission to present this paper and to use in its compilation data which have been collected in the Woodall-Duckham Laboratories.



EFFECT OF OILING BACK ON THE CONSISTENCY OF ROAD TAR.

LOG. LOG. 10.C. − LOG. LOG. 10 C.1 = M. x O/T.

WHERE.

C. = CONSISTENCY OF THE THICK TAR IN SECONDS.

C.1 = CONSISTENCY OF THE OILED BACK TAR.

M. = "OILING BACK" CONSTANT OF THE OIL USED.

O. = NUMBER OF PARTS BY WEIGHT OF OIL ADDED TO T. PARTS BY WEIGHT OF THE THICK TAR.

THE CHART MAY ALSO BE USED IN CONNECTION WITH THE EFFECT OF "TOPPING" ON THE CONSISTENCY OF ROAD TAR. IN THAT CASE "O" DENOTES THE NUMBER OF PARTS BY WEIGHT OF OIL DISTILLED FROM "T + O." PARTS OF A THIN TAR TO PRODUCE "T" PARTS OF THICK TAR.

NOTE.

IN CASES IN WHICH THE "OIL" USED HAS A VERY LOW M VALUE AND O/T BECOMES HIGH, MULTIPLY M. BY 10. AND DIVIDE O/T BY 10. IN USING THE M. AND O/T SCALES.

H. M. Spiers 12/9/29

THE WOODALL DUCKHAM Co.
LONDON.

EXAMPLE.

THE RAW MATERIAL IS A THICK TAR HAVING A CONSISTENCY OF 90 SECONDS. WHEN 12 PARTS BY WEIGHT OF OIL ARE ADDED TO 100 PARTS BY WEIGHT OF THE TAR, THE CONSISTENCY OF THE PRODUCT IS 8 SECONDS.

HOW MUCH OIL MUST BE ADDED TO THE THICK TAR TO OBTAIN A PRODUCT HAVING A CONSISTENCY OF 25 SECONDS.

ANSWER

5·6 PARTS BY WEIGHT OF OIL MUST BE ADDED TO 100 PARTS BY WEIGHT OF THE THICK TAR.

THE EXAMPLE SHOWS THAT THE "OILING BACK" CONSTANT OF THE OIL USED IS. 1·6.

APPENDIX.

Tables 1 to 15 inclusive are from analyses carried out in the Woodall-Duckham Laboratories.

Tables 16 to 19 inclusive are taken from reports by the Director of Fuel Research of tests carried out on the Parker, Crozier, Maclaurin, and Midland Coal Products low-temperature carbonization plants.

Horizontal Retort Tars.

1.

Sp. gr. at 60° Fahr. 1·205	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	2·6	0·9475
200–230°	6·7	1·028
230–270°	11·1	1·043
270–300°	4·35	1·063
Residue at 300°	74·85	
Loss	0·4	
Naphthalene	7·0	
Free carbon	21·7	
Crude tar acids	1·0 vol.	

2.

Sp. gr. at 60° Fahr. 1·240	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	2·4	1·016
200–270°	17·0	
270–300°	4·8	1·054
Residue at 300°	75·4	
Loss	0·4	
Naphthalene	6·0	
Free carbon	29·0	
Crude tar acids	3·0 vol.	

3.

Sp. gr. at 60° Fahr. 1·220	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	3·2	0·931
200–270°	15·35	1·019
270–300°	4·18	1·045
Residue at 300°	76·87	
Loss	0·4	
Naphthalene	3·0	
Free carbon	23·32	
Crude tar acids	5·5 vol.	

4.

Sp. gr. at 60° Fahr. 1·158	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	6·9	0·930
200–230°	9·7	1·014
230–270°	8·4	1·040
270–300°	5·0	1·060
300–350°	12·0	
Residue at 350°	57·6	
Loss	0·4	
Naphthalene	..	
Free carbon	..	
Crude tar acids	..	

Except where otherwise stated, all percentages are given by weight on the dry tar.

The values given for naphthalene, free carbon, and crude tar acids are estimated by the method used in road tar analysis.

Coke Oven Tars.

5.

Sp. gr. at 60° Fahr. 1·170	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	2·0	0·950
200–230°	3·0	1·005
230–270°	7·0	1·035
270–300°	6·0	1·060
300–350°	11·0	1·098
Residue at 350°	70·6	
Loss	0·4	
Naphthalene	5·0	
Free carbon	15·0	
Crude tar acids	4·5 vol.	

6.

Sp. gr. at 60° Fahr. 1·113	P.Ct.	Sp. Gr of Distillate.
Distillation of dry tar—		
−170° C.	0·3	
170–230°	9·8	0·961
230–270°	13·0	1·006
270–300°	6·9	1·035
300–380°	23·7	1·0975
Residue at 380°	45·8	
Loss	0·5	
Naphthalene	*Nil*	
Free carbon	5·0	
Crude tar acids	5·4 vol.	

7.

Sp. gr. at 60° Fahr. 1·156	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	2·2	0·960
200–230°	6·0	1·023
230–270°	11·9	1·040
270–300°	6·0	1·062
300–340°	8·6	1·100
Residue at 340°	65·1	
Loss	0·2	
Naphthalene	5·0	
Free carbon	3·0	
Crude tar acids	4·0 vol.	

8.

Sp. gr. at 60° Fahr. 1·165	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	0·7	
170–230°	8·5	1·013
230–270°	12·7	1·0475
270–300°	5·2	1·070
300–350°	10·3	1·111
Residue at 350°	62·3	
Loss	0·3	
Naphthalene	7·3	
Free carbon	6·3	
Crude tar acids	3·0 vol.	

Except where otherwise stated, all percentages are given by weight on the dry tar.

The values given for naphthalene, free carbon, and crude tar acids are estimated by the method used in road tar analysis.

Coke Oven Tar.

9.

Sp. gr. at 60° Fahr. 1·184	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	0·03	
170–230°	2·2	1·026
230–270°	10·8	1·045
270–300°	5·2	1·071
300–350°	13·8	1·106
Residue at 350°	67·1	
Loss	0·9	
Naphthalene	1·1	
Free carbon	5·0	
Crude tar acids	5·5 vol.	

Inclined Chamber Tar.

10.

Sp. gr. at 60° Fahr. 1·167	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·0	
170–230°	11·2	0·998
230–270°	11·1	1·039
270–300°	4·4	1·059
300–340°	8·4	1·096
Residue at 340°	63·8	
Loss	0·1	
Naphthalene	4·4	
Free carbon	3·5	
Crude tar acids	5·1 vol.	

Vertical Chamber Tar.

11.

Sp. gr. at 60° Fahr. 1·133	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	0·5	
170–230°	11·6	0·981
230–270°	12·0	1·0185
270–300°	6·8	1·044
300–350°	11·4	1·086
Residue at 350°	57·6	
Loss	0·1	
Naphthalene	0·5 about	
Free carbon	2·0	
Crude tar acids	5·8 vol.	

Except where otherwise stated, all percentages are given by weight on the dry tar.

The values given for naphthalene, free carbon, and crude tar acids are estimated by the method used in road tar analysis.

Vertical Retort Tars.

12.

Sp. gr. at 60° Fahr. 1·125	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·4	0·866
170–230°	12·1	0·942
230–270°	8·5	0·990
270–300°	6·8	1·012
300–350°	11·6	1·0535
Residue at 350°	59·4	
Loss	0·2	
Naphthalene	..	
Free carbon	7·0	
Crude tar acids	4·8 vol.	

13.

Sp. gr. at 60° Fahr. 1·11	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·7	0·8705
170–230°	11·1	0·940
230–270°	10·3	0·9885
270–300°	6·6	1·0155
Residue at 300°	70·0	
Loss	0·3	
Naphthalene	..	
Free carbon	6·0	
Crude tar acids	5·5 vol.	

14.

Sp. gr. at 60° Fahr. 1·102	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·2	0·872
170–230°	14·7	0·959
230–270°	12·5	0·998
270–300°	6·8	1·0145
300–350°	10·0	1·0325
Residue at 350°	54·8	
Naphthalene	1·0	
Free Carbon	..	
Crude tar acids	8·8 vol.	

15.

Sp. gr. at 60° Fahr. 1·085	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−200° C.	7·1	0·888
200–230°	8·8	0·950
230–270°	12·2	0·985
270–300°	6·5	1·003
300–319°	5·9	1·018
Residue at 319°	59·2	
Loss	0·3	
Naphthalene	*Nil*	
Free carbon	low	
Crude tar acids	7·8 vol.	

Except where otherwise stated, all percentages are given by weight on the dry tar.

The values given for naphthalene, free carbon, and crude tar acids are estimated by the method used in road tar analysis.

Low-Temperature Tars.

Externally Heated Processes.

16.

Sp. gr. at 60° Fahr. 1·063	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	4·7	0·855
170–230°	14·9	0·960
230–270°	12·9	0·996
270–310°	18·1	1·041
Residue at 310°	48·4	
Loss	1·0	

17.

Sp. gr. at 60° Fahr. 1·028	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	4·1	0·831
170–230°	11·7	0·931
230–270°	11·9	0·967
270–330°	15·7	1·001
Residue at 330°	55·9	
Loss	0·7	

Internally Heated Processes.

18.

Sp. gr. at 60° Fahr. 1·035	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·1	0·802
170–230°	13·9	0·934
230–270°	16·0	0·975
270–310°	12·8	1·002
310–350°	20·3	1·022
Residue at 350°	35·5	
Loss	0·4	

19.

Sp. gr. at 60° Fahr. 1·076	P.Ct.	Sp. Gr. of Distillate.
Distillation of dry tar—		
−170° C.	1·1	0·860
170–230°	3·9	0·950
230–270°	4·1	0·990
270–360°	26·9	1·030
Residue at 360°	63·2	
Loss	0·8	

Except where otherwise stated, all percentages are given by weight on the dry tar.

Midland Junior Gas Association

Presidential Address of Mr. W. Macnaughton

There was a large attendance of members of the Midland Junior Gas Association at the annual meeting held at the Council House, Birmingham, on Thursday, Oct. 9.

The new President is Mr. W. Macnaughton, Assistant Engineer of the Wolverhampton Gas Company, who succeeds Mr. A. R. Myhill, Birmingham; Mr. W. L. S. Spinks, Birmingham Gas Department, becomes the Senior Vice-President; and Mr. F. A. C. Pykett, of the Coventry Gas Department, Junior Vice-President.

Mr. H. W. Wills continues as Hon. Secretary, with Mr. F. A. Grant as his assistant; Mr. Geo. W. Smith as the Treasurer; and Mr. W. P. Timbrell as Hon. Auditor.

A vote of thanks to the retiring President was moved by Mr. MACNAUGHTON, who referred to the efficiency and thoroughness with which Mr. Myhill had carried out his duties; and this was seconded by Mr. SPINKS.

Mr. MYHILL, in acknowledging the vote, said he had always felt it to be a pleasure to do anything he could for the Association. He had served on the Council; he had been Hon. Treasurer; and he had contributed papers at their meetings. He appreciated highly the warm co-operation he had received from the Council and the members generally. Mr. Macnaughton would, he was sure, make a very capable President, for he knew the Scotch thoroughness with which he did everything.

THE PRESIDENT,

W. MACNAUGHTON, Assoc.M.Inst.Gas E.

Mr. Macnaughton was educated at Sherry's College, Glasgow, also at the Royal Technical College, Glasgow. He received his early training with the Coatbridge Gas Company, and was from 1913 to 1917 Chief Assistant at the Armadale Gas Company. In 1917 he joined the Technical Staff of the Coventry Corporation Gas Department, and during the latter period of his time at Coventry was Assistant Works Superintendent at the Foleshill Works. In 1920 he was appointed Assistant Works Superintendent to the Wolverhampton Gas Company, and in 1929 was promoted to that of Assistant Engineer. For the past three years he has served on the Midland District Gas Education Committee.

The SECRETARY referred to a motor accident which recently befel a member of the Association—Mr. H. G. Tipper, of the Nechells Works—and it was decided officially to convey to him their best wishes for a speedy recovery.

PRESIDENTIAL ADDRESS

of WILLIAM MACNAUGHTON, Assoc.M.Inst.Gas E., Assistant Engineer, Wolverhampton Gas Company.

During the last ten years the consumption of gas in Wolverhampton has increased at a moderate rate. In 1920 it was 1,086,239,000 c.ft.; last year it was 1,239,368,000 c.ft.

The works are divided into two sections by the Birmingham Canal, as follows: No. 1 Section, containing the C.W.G. sets, with necessary cooling, washing, and purifying plant; the main governor houses with boosting plant; works office; laboratories; and four gasholders. No. 2 Section, containing the complete coal gas plant, bye-product plants, repair workshops, stores, coke screening plant, power house, and one gasholder.

All gas supplied is produced at one station, and all coal used is carbonized in Woodall-Duckham retorts. There are three ranges of these retorts, as follows: No. 1 Range, 16 5-ton W.-D. vertical retorts; No. 2 Range, 16 7-ton W.-D. vertical

Working Results—Years Ended Dec. 31.

—	1929.	1928.
	Thousands.	Thousands.
Coal gas made—		
No. 1 Inst.	435,383	207,165
,, 2 ,,	65,665	367,649
,, 3 ,,	486,921	304,245
Total	987,969	879,059
C.W. gas made	322,695	402,920
Total ,, ,,	1,310,664	1,281,979
Coal gas delivered	987,899	879,247
C.W. ,, ,,	322,653	402,906
Total ,, ,,	1,310,552	1,282,153
Corrected for barometer and thermometer:		
Coal gas made—		
No. 1 Inst.	430,186	203,073
,, 2 ,,	67,335	364,039
,, 3 ,,	476,274	299,732
Total	973,795	866,844
C.W. gas made	323,543	400,666
Total ,, ,,	1,297,338	1,267,510
	Tons.	Tons.
Coal carbonized—		
No. 1 Inst.	24,099	11,731
,, 2 ,,	4,067	21,802
,, 3 ,,	27,211	18,224
Total	55,377	51,757
	C.Ft.	C.Ft.
Gas made per ton of coal—		
No. 1 Inst.	18,066	17,659
,, 2 ,,	16,145	16,863
,, 3 ,,	17,894	16,694
Average	17,840	16,984
Gas made per ton of coal (corrected)—		
No. 1 Inst.	17,850	17,310
,, 2 ,,	16,556	16,697
,, 3 ,,	17,503	16,447
Average	17,584	16,748
	Therms.	Therms.
Therms made per ton of coal (corrected)—		
No. 1 Inst.	82·03	79·88
,, 2 ,,	76·40	77·17
,, 3 ,,	80·51	76·54
Average	80·85	77·56
Coke saleable	25,008 tons	24,707 tons
Ditto per ton of coal	0·451 ,,	0·477 ,,
Coal gas tar made	862,798 galls.	826,320 galls.
Ditto per ton of coal	15·58 ,,	15·96 ,,
Liquor made, 10 oz.	1,501,352 ,,	1,459,482 ,,
Ditto per ton of coal	27·11 ,,	28·19 ,,
Benzole made	10,553 ,,	11,469 ,,
Ditto per ton of coal	1·12 ,,	0·97 ,,

Coal carbonized per retort per 24 hours:

5 tonners	4·7 tons	in summer months to
	5·1 ,,	,, winter ,,
7 tonners	5·6 ,,	,, summer ,, to ,,
	6·8 ,,	,, winter ,,

Coals in Use.	1929.	1928.
	P.Ct.	P.Ct.
South Yorkshire	48	46
Nottinghamshire	13	10
North Wales	20	23
North Staffordshire	19	21

retorts; and No. 3 Range, 16 7-ton W.-D. vertical retorts. Two of these ranges are usually at work, but if the demand is exceptionally heavy in winter time the third range, or part of it, is added for about a month or so.

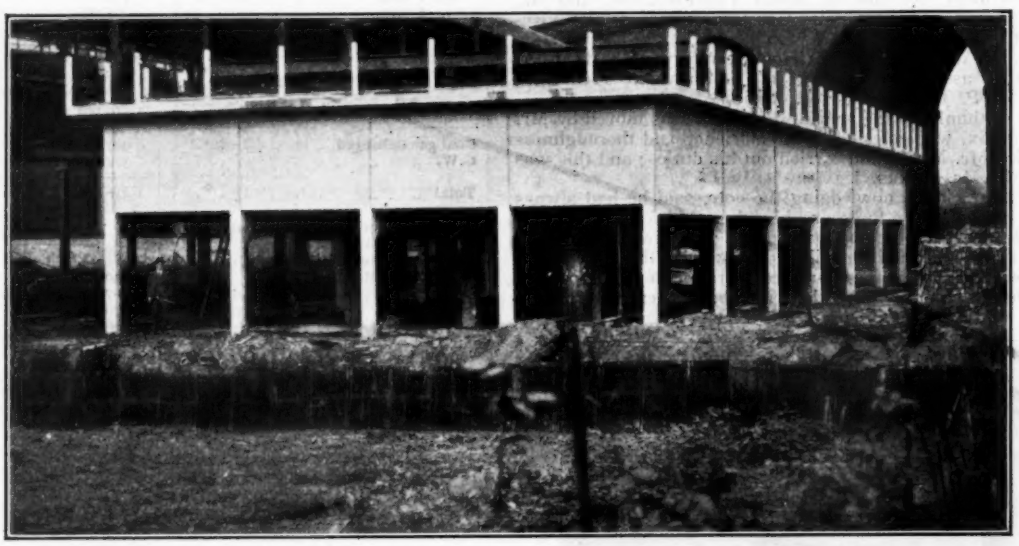
The retort house mains are so arranged that when two ranges are being worked each stream of gas is entirely separate from the other—that is, as far as condensing, exhausting, washing, purifying, and metering are concerned. This, to my mind, is an important point, for when working (say) No. 1 Range and No. 3 Range, the comparative results can be easily determined.

purifiers the following weights and pressures were provided for, and the boxes were designed to have a factor of safety of 4, having due regard to all the conditions.

Weight of oxide in each purifier . . .	175 to 200 tons
Weight of iron grid bearers	10½ tons
Weight of steel covers	2 tons 10 cwt.
Weight of cover lifting crane	7 tons

Pressure of gas 48 in. water column equal to 252 lbs. per sq. ft.

[At this stage, Mr. Macnaughton outlined the conditions under which the work was carried out.]



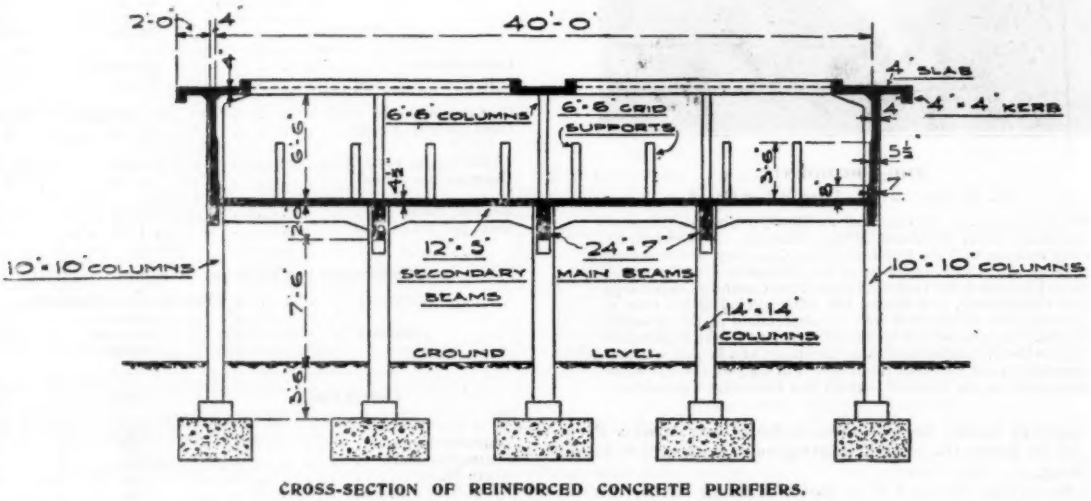
REINFORCED CONCRETE PURIFIERS.

All coal delivered to hoppers, whether taken from store or railway sidings, is weighed. Works costs are worked out every week, and as our week ends at 6 p.m. on Thursday, all coal bunkers are filled to the same level each Thursday afternoon.

Reinforced Concrete Purifiers.

Previous to the war the use of concrete in this country for the construction of moderate size boxes was very limited, although there were a few cases in small works where concrete boxes had been in use for many years. Since the war this type of

After erection, the covers were lowered, fastened down in the usual manner, and the top deck was flooded with water to a depth of 3 in. Air was then pumped into the boxes, and when the pressure has reached 20 in. it was visible that there were innumerable small leaks on the roof. After much thought and consultation, it was decided to try to get the boxes gas-tight with the use of cement only. The inside of the boxes—that is, the floor, side walls, and roof—was rendered with a ⅜ in. thickness of super-cement, care being taken that the rendering was not applied just after mixing, but just before it commenced to



CROSS-SECTION OF REINFORCED CONCRETE PURIFIERS.

construction has been gradually gaining favour, and to-day there are many installations at work.

In 1919, when the question of increasing purifying capacity at Wolverhampton was considered, designs and specifications were prepared both for cast-iron and reinforced concrete boxes. As the tenders submitted showed a saving of 33 p.ct. in favour of reinforced concrete, this method was adopted. The boxes are three in number, 40 ft. by 40 ft. by 6 ft. 6 in. deep, and built on reinforced concrete piers 9 ft. 6 in. overhead, the underneath area serving as a revivifying floor. In the design of the

set. This having been done, the boxes were again tested according to specification, proved sound, filled with oxide, and put to work. They have been in constant use since February, 1921, and have purified 4600 million c.ft. of coal gas.

Some months after putting the boxes to work it was observed that there was a slight leakage of cyanide and other liquors on two boxes where the plane of stoppage of concreting took place. This leakage was easily stopped when the boxes were being emptied by grooving, V shaped, on the inside of the floor of the box to a depth of 1½ in., and filling with a roofing compound or

mastic. The outsides of the boxes are cement washed every two years.

Working temperatures in this form of purifier construction may be a consideration, but we are continuously working the purifiers at a temperature of 90° to 130° F. with no ill effects. I may also add that we have had two minor explosions with the usual oxide fire when emptying a box, with no detrimental action on walls or roof. I should like to emphasize that the boxes are gas-tight without the use of any expansion joints or the application of any tar, paint, or other protective coating when the boxes are changed from time to time. As previously stated, the boxes are built 9 ft. 6 in. above ground level, which enables us at any time to examine all outside surfaces. There is just one point with reference to the use of concrete for purifier construction, which is that, once erected, they cannot be dismantled and built up again in another position, as can be done in the case of cast-iron plate boxes.

Water Softening.

The problem of water softening for boiler feed purposes has during the past few years become very acute, more especially with the ever-increasing use of tubular waste-heat boilers. The system to be briefly described is the outcome of many years of experiment and research, and is known as the Neckar system of water treatment and boiler control.

Briefly, the idea is this: As the boiler feed water is required hot, the water which is abstracted from the boiler for the prevention of sludge concentration may be taken back into the softener, giving up its heat there to the feed water and depositing in the softener itself the sludge formed in the boiler. After the idea had been first conceived, it was found that a small continuous stream of boiler water would keep a boiler clean, providing that soda was always present in excess; and the very feature of this continuous sludge return installation allowed the inventors to add in the softening tank once and for all an excess of soda, as this excess could at all times be circulated and the alkalinity in the boiler water always kept within safe limits.

The heating effected by the returned boiler water and the presence of a little caustic soda in this returned water (produced from soda ash at the high temperature and pressure experienced in the boiler) rendered the use of lime entirely unnecessary. Soda ash is the only chemical required. The use of intricate distribution gear is unnecessary, as the quantity of excess soda in circulation in the softener and the boiler is large compared with the periodical addition. It is only necessary to test the boiler water daily for alkalinity, and add to or reduce the quantity of soda ash. The permanent hardness is thus precipitated by means of soda ash, while the temporary hardness is precipitated by the combined action of the heat and the excess soda in circulation, as much of this excess in the boiler is transformed into caustic soda, which attacks the temporary hardness.

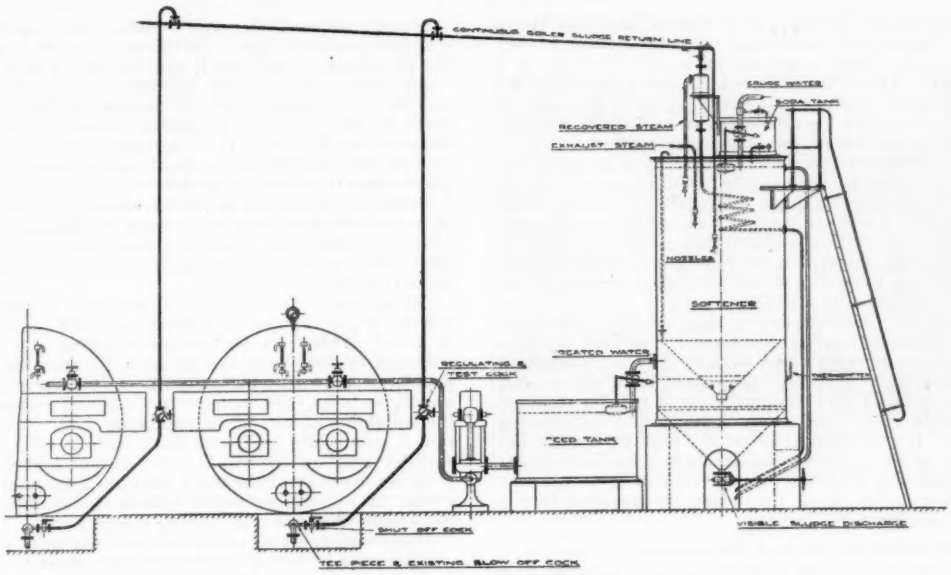
It is usually thought that the temporary hardness cannot be precipitated except by prolonged boiling or by the addition of lime, but it was found by practical application that a temperature of 160° to 180° Fahr. is quite sufficient when the softening is assisted by the caustic soda and the excess sodium carbonate contained in the sludge return water.

Thus a softener was devised whereby, by the use of one chemical only, the application of the heat previously blown to waste, and the passing to the softener of surplus exhaust steam, the hardness of the crude water is reduced to about 1° to 2° of temporary hardness; and, further, by means of the continuous sludge return, the sludge forming in the boiler from these few degrees of residual hardness is abstracted from the boiler before it can deposit.

The maintenance of the fixed alkalinity in the boiler ensures freedom from calcium sulphate or any other permanent hardness in the boiler water, which salts when precipitated would otherwise, even when present in small quantities only, be the cause of binding the other scale-forming salts together, so that they would bind on to tubes and boiler plates as a hard scale.

As regards corrosion, the heat treatment of the crude water causes the gases absorbed in the water to be driven out of the feed water before it is pumped to the boilers. This feature, combined with the fact that the boiler water contains a slight amount of sludge, and the fixed alkalinity of the boiler water, provides a possible preventative against the action of corrosive gases on the boiler plates.

Previous to August, 1929, the boiler feed water used was the Wolverhampton town supply with the addition of a feed water softening compound. Although fairly satisfactory results were obtained on Lancashire boilers at our coal gas section working under an easy load, we were continually having to push back bulges in the fire tubes of the Lancashire boilers at the C.W.G. plant, which were steaming rather heavily. Also, on the waste-heat boiler on our coal gas plant we were having a certain amount of trouble through tube plates leaking, no doubt due to the thin layer of scale forming on both types of boiler. Another point was that we had an abundant supply of brook and well water on the works which could be had for the cost of pumping against the high cost of town water.



NECKAR WATER SOFTENING PLANT.

The Neckar plant was put to work in August, 1929, and so far we have not had to put one single boiler off either for leakage or for tubes bulging. Scaling of boiler, either by hand or by mechanical means, has been done away with, as a hose pipe is the only thing required when preparing a boiler for annual insurance examination. The actual twelve months' saving on this plant taking brook and well water and soda ash against town water, softening chemical, and boiler scaling, has been £1064.

Distribution.

As previously stated, the whole of the gas supplied is manufactured at one station; and, as there are no outlying gasholders, the method of distribution may prove of interest. From our main governor house we have two 24-in., one 16-in., and one 12-in. cast-iron mains conveying gas to the centre of the town. During the hours of heaviest demand, and also for lighting and extinguishing lamps fitted with Broadberry controllers, resort has to be made to boosting. The boosters are in a house adjoining the governor house, and are of the following capacities: Two single-inlet Rateau fans, each to pass 400,000 c.ft. of gas per hour at 1420 r.p.m. against 7 in. pressure difference, driven by 20-H.P. De Laval steam turbines. To our Heath Town district we have a 14-in. cast-iron main.

During 1929, owing to the increased consumption in this area,

we were obliged to install a booster of the foregoing type capable of passing 300,000 c.ft. of gas per hour. The supply to the villages of Codsall and Bilbrook, which are approximately five miles from the works, is conveyed by a 4-in. high-pressure weldless steel main. From 6 a.m. to 12 midnight the pressure in this main varies between 1½ to 8 lbs. per sq. in., according to the demand, and during the remaining hours, or when the compressor has been stopped, the holder pressure is sufficient to give the volume of gas required.

The main pressure is reduced by means of a Reynolds 4-in. low-pressure reducing regulator. The compressors are of the following sizes: One 10 in. by 13 in. by 10 in. horizontal duplex steam-driven reciprocating compressor complete with flywheel to pass 30,000 c.ft. per hour at 190 r.p.m., against 40 lbs. per sq. in. Two steam-driven rotary compressors capable of passing 16,000 c.ft. per hour against a pressure of 5 lbs. per sq. in.

The future success of the gas industry depends almost entirely on the selling price of our main product, and service to consumers. To achieve this object, now that we are living in a competitive age, it behoves everyone of us to try to master the particular grade of the industry in which he is engaged.

To the President a hearty vote of thanks was passed on the motion of Mr. MYHILL, seconded by Mr. H. R. HEMS.

Cumberland and Westmorland Gas Managers' Association

DEVELOPMENT OF GAS SALES IN THE SMALLER UNDERTAKINGS

By J. CORRIGAN, Engineer and Manager, Penrith Gas Department.

This paper was read at a Meeting of the Association held at Maryport on Oct. 9, in conjunction with the official opening of a Glover-West vertical retort installation at the Gas-Works of the Maryport Urban District Council.

During the years of existence of the Cumberland and Westmorland Gas Managers' Association the discussions at our meetings have been directed mainly to works problems of a technical nature. These discussions have proved of immense value to the manager of the small works, since he has had the opportunity of presenting his difficulties to colleagues who can fully appreciate the nature of these particular problems.

I propose, however, in this paper to deal with the gas sales side of our undertakings. In order to illustrate certain aspects I have found it necessary to quote the results of certain recent efforts at Penrith. These are not put forward in the nature of ideals, but rather in the hope that other members will pool their experiences, for I feel that we have sufficient knowledge of each undertaking to be able to interpret these results in the light of the particular local conditions.

It will be readily conceded that during the next few years there will be in this district considerable electrical development. Many of our members have been in the past, and are at present, experiencing very severe competition from this source, and it is quite certain that every undertaking will, in the near future, be brought up against electrical competition of an even keener nature. It is essential, therefore, that we should immediately take stock of ourselves, carefully examining every branch of our business from the point of view of modern conditions and endeavour to bring the whole undertaking into a state of sound efficiency.

POSITION OF SMALL UNDERTAKINGS.

Before proceeding with the methods of sales promotion it would be well to consider the position of the small gas undertakings. The general trend of business development, both in local government and private enterprise, appears to be in the direction of amalgamation and absorption, with the subsequent elimination of the smaller concerns. Many of such amalgamations have taken place in our own industry to the apparent mutual satisfaction of all parties. The main factor in the majority of these cases, however, has been an adaptable geographical situation; but the real question is that of the small undertaking comparatively isolated, speaking in terms of present gas distribution.

It is rather unfortunate that there is an impression growing among the general public that all small businesses will eventually disappear, and that in the meantime the public must expect a lower standard of service from the small people. This impression may be correct of certain industries, but, as pointed out by Mr. Blundell in his recent paper to this Association, the very nature of gas production renders it possible for the small works to be as thermally efficient as the large works, and it has been proved in practice that there are many small undertakings as commercially efficient as the larger ones.

Let us consider what a modern public demands of a commodity. It may be summed up in two qualities and in the following order:

(*a*) A reliable supply of the commodity.
(*b*) A reasonable charge.

These qualities are required of all gas undertakings. We must now examine how near the small works can approach the ideal.

RELIABLE SUPPLY OF THE COMMODITY.

In applying this requirement to our particular commodity it must cover the three main phases of manufacture, distribution, and maintenance.

Manufacture.—Under this heading the requirements are a constant quality of gas. Furthermore, to those working under the provisions of the Gas Regulation Act it is now a statutory requirement. This is not intended to be a "works" paper, and for that reason I do not propose to discuss in detail the methods that might be adopted to obtain the desired end of a constant quality gas. It is, however, correct to say that the present-day manager of a small works has better facilities at his disposal than had his predecessor of many years ago. Careful attention to details is still demanded, but the extended use in small works of manual charges to horizontal retorts, indicators, recorders, &c., and the adaptation of vertical retorts to the smaller works has greatly assisted the manager in giving a more regular quality of gas.

Distribution.—In brief, the consumer requires a constant quality of gas supplied at sufficient pressure to the appliance he is using. This calls for our investigation into the whole distribution system, commencing with the adequacy of the initial pressures thrown by the gasholder, the sizes and conditions of mains, services, and meters, the internal pipings, and, lastly, the suitability of the actual appliances used. The whole question is essentially one to be dealt with locally, but it must be realized that an inadequate distribution system nullifies the progress made in producing a constant quality of gas, and *vice versa*. A sound distribution system is not much assistance if the supply of gas is of a varying quality.

Maintenance.—This reliability does not refer so much to the maintenance of actual appliances (this must be considered an essential to any sound distribution system), but rather to the reliability of the undertaking in its dealing and maintaining contact with the consumers—for example, its attitude towards inquiries and complaints, prompt attention to orders, fulfilment of promises, and its genuine offers of service—in short, its ability to create the feeling among the consumers that "the gas company will not let you down."

REASONABLE CHARGE.

I have placed the quality of reliability before the reasonable charge, because I am convinced that the average consumer is prepared to pay a little more for a better article in the form of consistency. Naturally, each undertaking must offer its gas at the lowest possible economic rate, but only after the reliability of supply has been assured. It is a mistake to assume that the undertakings supplying the cheapest gas are in the soundest position to meet competition. They have no doubt a great advantage, but the deciding factor will be the additional quality of its service to the consumers.

I have dealt at some length with these fundamentals, as I feel they are particularly important to the manager of the small works, because, after having been directly responsible for the manufacture of the gas, he will probably directly sell appliances to the consumer. He naturally feels a personal responsibility in their performance, and if he is conscious of any shortcomings in the manufacture and distribution system, it must have the serious effect of creating a loss of confidence in his own product.

SALES DEVELOPMENT.

The aim of all gas undertakings is to increase their sales of gas. It is only in the method of approach that the smaller undertakings differ from their larger neighbours. Speaking generally, the small works lack the elaborate showrooms and the extensive local advertising campaigns which are considered

necessary by the larger works to bring the service of gas to the notice of their consumers. On the other hand, they possess the great advantage of being more easily able to establish, through their management, personal contact and confidence.

The policy of sales development should, therefore, to my mind, be moulded on methods which further this personal contact. The principal methods normally available for increasing sales of gas are:

(1) Advertising, (2) Showrooms, (3) Exhibitions and demonstrations, (4) Instalment system of fittings purchase, (5) Discounts and rebates, (6) Street and public lighting.

Newspaper advertising is usually an expensive form of propaganda for the small works owing to the comparatively small circulation among the gas consuming public in the area; and in many cases there is considerable overlapping of circulation of country papers. I would suggest that certain areas in our district are very suitably placed for a joint advertisement on general gas matters to be run by the interested undertakings. It would be a very effective method of showing the co-operation between those gas undertakings, and at the same time would prove a useful backing up of the National advertising of the British Commercial Gas Association.

The success of showrooms depends to a great extent upon their locality in relation to passers-by or in their securing patronage by reason of gas accounts being paid at the showrooms. Many small undertakings, particularly municipally-owned ones, have accounts payable away from the works or showrooms. In these cases it is extremely difficult for the gas department to attract the attention of their consumers to the showrooms and other methods must be devised. Where patronage can be assured, even the smallest showroom can be made effective by a clean, representative display of the seasonal appliances.

Much has been said in the Technical Press of the doubtful value of exhibitions, but each local case should be considered, particularly in regard to its existing showroom facilities. Properly organized, a public gas exhibition in a small town creates quite an event and leaves a lasting impression, more so than would be the case in a larger town, where there appears to be a surfeit of trade and other exhibitions. Cookery demonstrations are very popular indeed with the gas consumers and even though the actual business done at the demonstration does not appear to be great, nevertheless a good and useful service is being rendered. Advantage should also be taken of co-operating with any firm offering to show gas appliances at trade shows or exhibition houses, &c. While on the subject of exhibitions, may I give the result of an exhibition held at Penrith in October of last year. I would explain that we are handicapped in the way of showrooms, having only a room at the work's office (gas accounts being paid at the Town Hall) and a small showroom in the local Market Place opened on Market Day mornings and Saturday evenings. Nevertheless, previous business had been fairly satisfactory, and the exhibition was intended more in the nature of a refresher.

During the five days, cookery demonstrations were attended by 2500 people, giving an average attendance at the lectures of 250. The total sales during the exhibition exceeded £750 and comprised 60 cookers, 20 fires, 10 irons, 2 hotplates, and 2 radiators, while the lighting stall turned over £60 worth of goods. Since then we have held further exhibitions in conjunction with makers of flour, &c., and have recently completed a 10 days' special display devoted entirely to gas lighting, switches, and fires.

Every facility should be given to consumers to possess their own appliances. By extending the years of hire purchase to three or five years the instalments become little more than simple hire. On the question of cookers, the all-enamelled "Regulo"-controlled cooker has proved a remarkable selling factor and advertisement for gas, and has undoubtedly created quite a different appearance in the average kitchen. Personally, I should hesitate before spending money on anything but all-enamelled cookers because they have made strikingly obvious the claims that gas is "clean and labour-saving." Our whole attitude should be to persuade the consumers to own rather than hire an appliance, since a person will not readily dispose of something already paid for.

On the other hand, if a simple hire scheme is operating, the rates charged should be set to allow the gradual replacement of appliances.

Discounts and Rebates.

A scale of graduated discounts arranged to offer a direct incentive for the increased use of gas is a very attractive scheme. I do not propose to discuss the pros and cons of the two-part tariff or other alternative methods of charges for gas, but I can assure members that it is worth their while to investigate very thoroughly the effect such schemes would have on the finances of the undertaking. I am at present engaged on such a preliminary investigation and the necessary tabulation of individual consumptions reveals a striking disparity between apparently similarly situated consumers.

With regard to the slot consumers the operation of a rebate system is a valuable adjunct to increasing sales of gas by virtue of its effect on improving the goodwill of the consumers. There are many advantages in the system—for example, saving of changing meter dials or wheels, change of tenancy is reported immediately, the adaptability of instalment payments, &c.

There must, however, be a line of demarcation in the amount of rebate given, below which the low basic allowance of cubic feet per 1d. might react upon the consumers, giving them the impression that the gas charges were exceedingly high. Collectors who have operated the net and rebate systems are conscious of a different atmosphere which greets their arrival to empty the meter. The consumers are usually in a very pleasant state of mind anticipating the amount of the rebate, and that moment is a very suitable one for the judicious suggesting of the purchasing of further gas appliances payable through the meter rebate allowance.

Public Lighting.

One cannot over-estimate the value of good street lighting as a medium for the retention and expansion of the lighting load. It is unfortunate that in many cases the gas undertaking has no direct control over the street lighting, and yet the lamps are taken as a silent testimony of the efficiency of gas lighting. Bad street lighting reacts not only upon the lighting load, but has also a detrimental effect upon the gas undertaking as a whole. Further, the character of a town is very often judged by its attitude towards street lighting, and certainly in this era of night motoring a well lit town creates a good impression and is advertising itself well.

It can be quite definitely stated that for street lighting gas is the most suitable form of illuminant. It is reliable, economical, and possesses the great advantage of higher penetration powers through fogs. I would, however, urge our members who are directly responsible for the street lighting to modernize the system, even at a cost to themselves. May I relate a street lighting experience in Penrith. Three years ago the Surveyor to the Urban District Council adopted a very progressive policy of modernization of lamps. There were at that time some 250 lamps on the district of various shapes and sizes, all hand lit. During the summer time every burner on the system was scrapped, and new cluster burners of the superheated type complete with clock controller were fitted to every lamp. Special attention was paid to renewing defective lamp services, many new lanterns and reflectors were fixed, and generally the whole system was overhauled. From the point of view of gas lighting publicity the real value lay in the fact that every lamp in the town commenced the lighting season on the same evening with a new burner and mantles. The improved lighting was thus most apparent and freely commented upon, and each year further additions and improvements are being carried out by increasing the candle-power of lamps in prominent positions. A very economical improvement can be obtained by increasing the height of the lamps to 13 ft. 6 in. by the addition of short extension pieces to the column. Larger lanterns and the superheated row or cluster of 4 No. 2 mantles are fixed, and the whole replacement is very effective.

In the same way with public buildings, the older fittings are being replaced with modern distance-controlled lamps of vari-

Remarkable success has attended recent selling efforts of the Penrith Urban District Council, of which Mr. John Corrigan is Engineer and Manager. Within the last twelve months two seven-day public exhibitions have been held, in addition to special shows at trade demonstrations and exhibition houses. The actual sales at the two exhibitions totalled £1360, comprising 97 cookers, 55 fires, 19 irons, 3 hotplates, 12 radiators, &c., and the total sales for the year have easily created a record. Owing to lack of adequate showroom facilities and particular local circumstances the gas lighting business had become stationary. As a result of recent special propaganda and demonstrations the sales of lighting fittings have shown a surprising increase. Whereas the average annual sale before was in the region of £20, the total year's sales to March 31, 1930, amounted to £250, while the current six months' total is approximately £180. Further lighting business is being secured through the payment-through-meter method.

ous sizes. The Public Library and Reading Room has been recently re-organized, and the lighting is now done by means of 14 4-light reflector lamps fitted with special silent nipples, and those lamps between the book shelves are operated by "Newbridge" switches, proving a very economical proposition. Inside each of the library books was placed a gas publicity bookmarker.

Meeting Electrical Competition.

The foregoing remarks have referred principally to what might be termed normal business methods. In approaching the question of meeting local electrical competition, the attitude of most gas undertakings appears to be governed by the intensity of the competition they are at present receiving from that source. It will be agreed that for certain purposes and under certain conditions electricity possesses many advantages, and for that reason the policy of a gas undertaking should be developed not on anti-electric but rather on progressive pro-gas lines. A careful study of electrical supply will reveal two distinct weaknesses.

1. The low thermal efficiency of its manufacture and distribution.

This may be clearly shown in the following example. If 100 tons of coal are carbonized on a modern gas-works, 75 tons of the original coal would be recoverable in the form of gas, coke, and tar. If 100 tons of coal are used at a modern electrical station, 18 to 20 tons of the original coal would be delivered to the consumers in the form of electrical current. This is really the fundamental fact why gaseous fuel can be supplied much more cheaply than electricity.

2. Its inferiority in comparative cost values with gas.

In the matter of comparative costs, undertakings working under the therm system are in a good position to present the true facts to the public.

1 therm of gas contains 100,000 B.Th.U. 1 kilowatt (or B.o.T. unit) of electricity contains 3415 B.Th.U., so that 1 therm of gas contains as much heat as 29 units of electricity.

In actual practice, however, the comparison must be based upon the performance of the respective fuels in the particular appliance used. That is to say, in certain types of appliances the electrical unit would develop its full amount of heat, while the gas therm would not be so efficient.

Allowing for these differences, it has been borne out that for all practical purposes the commercial value of a gas therm may be considered the equivalent of 24 units of electricity. On this basis, where gas is supplied at (say) 8d. per therm, the corresponding electrical charge to render the same heat to an appliance would be one-third of a penny per unit. To put it in another way, if electricity ever reaches the much vaunted price of "1d. per unit for all purposes," gas would render an equivalent heat even at 2s. per therm.

Domestic Lighting.

In spite of being able to show these economies for gas, it will be found that the majority of people who put in an electric supply do so primarily for the lighting, when the respective costs of gas and electricity must have been quite a secondary consideration. The present attitude of a gas undertaking to gas lighting will depend upon the extent of the inroads that electricity has made into that particular lighting load. It is quite certain that any undertaking that really means now to make a fight to retain the lighting load is in a far better position than it was a few years ago. The general manufacturing standard of gas lighting burners has been greatly improved, and the adaptation of the distance control devices and switches, together with the new artistic and decorative effects, has produced quite a different outlook for the future of gas lighting. There is also the distinct advantage that the incandescent burner gives off an appreciable amount of heat. The loss of this heat is very noticeable when electricity is installed, and particularly so in the artisan type of house which is being given special attention under the electrical assisted wiring scheme. There have been, in different parts of the country, thousands of cases where consumers have returned to the gas lighting on the main score of cost of renewing of electric globes, loss of valuable heat from the gas lighting, and higher running costs of electricity.

The principal methods by which gas lighting loads can be retained are:

1. Constant demonstrations of the most modern types of lighting.

The average person will not believe gas is capable of giving good results for lighting purposes unless they see it. Newspaper or leaflet advertising has not much convincing power, even in regard to comparative values. Most of the calculations one sees are in candle-power-hours, &c., and it requires quite a little thought on the part of an experienced person to understand the full meaning of the terms. A much better plan is to arrange a series of different sized burners—(say) 3 No. 2 cluster, 2 No. 2 cluster, universal, and Bijou—giving the number of hours for gas and electricity that the particular light can be obtained for one penny, under the current local charges. The consumer then can vizualize the light and the cost at the same time.

2. Sale of fittings through slot meter rebates.

Particular attention should be given to extending the gas lighting to unlit bedrooms, &c., at a fixed charge to cover piping, brackets, and labour complete, and give the option of paying for the installation through the slot meter rebate. This method provides an opportunity of meeting the electrical assisted wiring scheme.

3. Fixing of switches and distance control devices.

The "Newbridge" gas switch is proving a very valuable means of retaining the interest in domestic gas lighting, and when the additional improvement which eliminates the necessity for the by-pass is shortly placed on the market there will be no difference at all between the switching on of gas or electricity. For public buildings the Sugg's distance control device is a very reliable appliance.

Cooking and Heating.

Under this heading the average person does consider the running costs of gas and electricity, and invariably finds that gas is by far the most economical. At the present time, also, the electric cooking appliances are not reliable, but it is a mistake to feel secure owing to the mechanical faults of a rival appliance, because these faults will no doubt be gradually eliminated. Rather we should concentrate on showing the remarkable efficiency of the modern gas cooker, both in appearance and performance.

I will conclude by giving a few details of the undertaking which I represent. Penrith is an agricultural market town with a population of 8·073. There are no special industries, and the gas load is principally a domestic one. The following tables show the progress made in output:

Table No. 1.

—	Make of Gas.	Annual Increase.	No. of Consumers.	Sale of Gas.	Consumption per Consumer.
	C.Ft.	P.Ct.		C.Ft.	C.Ft.
1921 . .	54,004,000	..	2260	50,140,000	22,185
1922 . .	60,010,300	11·15	2298	56,622,700	24,639
1923 . .	62,119,600	3·44	2335	58,410,600	25,015
1924 . .	63,555,400	2·36	2387	58,513,000	24,513
1925 . .	65,450,900	3·09	2461	61,958,400	25,176
1926 . .	69,838,000	6·45	2495	64,793,200	25,963
1927 . .	70,665,000	1·18	2520	65,980,600	26,182
1928 . .	75,438,300	6·75	2560	69,380,600	27,101
1929 . .	78,489,600	4·04	2620	72,490,300	27,668
1930 (est.)	81,000,000	..	..	..	..

It will be seen that at the conclusion of this year there will have been an increase during the past ten years of 50 p.ct. in the output, and of 5500 c.ft. in the average consumption per consumer.

Table No. 2.

Year ended March 31.

—	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	Total.
Net gains in cookers fixed (*i.e.*, allowing for returns) .	26	33	7	20	20	96	52	81	112	43	95	585
Gas fires . .	29	36	8	36	43	47	68	48	75	59	82	531
Radiators, geysers, &c. . .	6	2	..	5	4	4	5	3	2	22	8	61
Gas boilers . .	20	19	15	25	33	34	36	29	42	35	34	322
Grillers, gas irons, &c.. .	2	3	8	6	13	29	12	18	14	6	30	141

In addition to the above list, nearly 300 gas boilers have been fixed in newly erected houses.

Declared Calorific Value of Gas—500 B.Th.U.

Prices of Gas.

Ordinary Consumers.

Up to 250 therms per half year . . . 7·2d. per therm (3s. per 1000 c.ft.). *Less* 5 p.ct. net price, 6·84d.

250–625 ,, ,, ,, . . . 7·2d. per therm. *Less* 10 p.ct. net price, 6·48d.

625–1250 ,, ,, ,, . . . 7·2d. per therm. *Less* 12½ p.ct. net price, 6·30d.

Over 1250 ,, ,, ,, . . . 7·2d. per therm. *Less* 15 p.ct. net price, 6·12d.

Slot Consumers.

Meters set 18 c.ft. per 1d. = 4s. 7½d., present rebate 25 p.ct. = net price 3s. 5½d. = 8·3d. per therm.

A maintenance scheme is in operation, which, with certain reservations, works under the labour-free, materials charged principle. Slot consumers have the option of a rebate fittings scheme, under which fittings may be purchased through slot rebate—the time allowed for completion of payment being twelve months. It is intended to apply chiefly to extension of lighting points to unlit rooms.

Manchester and District Junior Gas Association

Presidential Address of Mr. C. H. Bamber, B.Sc., of Bolton.

The Annual Meeting of the Association took place at Bolton, on Oct. 4, when over a hundred members assembled at the Works Offices of the Gas Street Works, and were received by the Gas Engineer, Mr. W. J. Smith, B.Sc., and the President, Mr. C. H. Bamber, B.Sc. Under the guidance of several members of the technical staff, the party were conducted over the works. Following the tour of inspection, visitors proceeded to the " Pack Horse " Hotel for tea. At the subsequent business meeting,

The PRESIDENT called upon the Hon. Secretary, Mr. J. Alsop, to read the Annual Report, which showed the number of members this year to be 271, including 4 hon. members—an increase of 19 on last year.

The death of one of the hon. members, Prof. H. B. Dixon, C.B.E., D.Sc., Ph.D., F.R.S., was reported, and the members stood in silence as a token of respect. A letter signed by the President and Secretary and addressed to the late Professor's wife was read, and a request made that it should be forwarded to her expressing the members' sympathy.

Mr. G. Haynes, late of Liverpool Gas Company, a former member, and father of a Past-President (Mr. J. T. Haynes) was also reported as having passed away some two weeks ago.

Two Presidents from Bolton.

On the right is Mr. W. J. Smith, B.Sc., M.Inst.Gas E., Engineer and Manager of the Bolton Gas Department, who is President of the Manchester District Institution of Gas Engineers; on the left is his Assistant, Mr. C. H. Bamber, B Sc., President of the Manchester and District Junior Gas Association.

It was further reported that the son of Mr. C. E. Teasdale (a Past-President) had met with a fatal accident recently.

The HON. TREASURER (Mr. I. H. Massey) read the Statement of Accounts.

The report and accounts were received and adopted.

ELECTION OF OFFICERS.

President, Mr. C. H. Bamber, B.Sc.
Senior Vice-President, Mr. H. C. Applebee, A.I.C., F.C.S.
Junior Vice-President, Mr. H. B. Knowles.
Hon. Secretary, Mr. J. Alsop.
Hon. Treasurer, Mr. I. H. Massey.
Hon. Auditor, Mr. F. A. Collier.

The following members were duly elected to the Council: Messrs. H. P. Lupton (Liverpool), J. Carr (Stretford), T. Reynolds (Stockport), and H. Platt (Bolton).

Mr. J. T. HAYNES moved a vote of thanks to Mr. F. B. Small, who had served for two years as Senior Vice-President, to which Mr. SMALL replied.

PRESENTATIONS.

The PRESIDENT called upon Mr. H. C. Applebee, and asked him to receive a drawing-room clock with Westminster chimes as a token of services rendered to the Association as President.

Mr. H. Platt was asked to receive a cut-glass bowl, as his paper read during the session had been adjudicated for the prize given by Mr. W. T. Glover.

Mr. J. CARR (Stretford) moved a vote of thanks to the members of the Gas Committee, coupled with the name of the Gas Engineer, Mr. W. J. Smith.

Mr. H. C. APPLEBEE (Manchester) seconded, and spoke of the scientific control of the works from the laboratory to every type of plant.

Councillor C. H. BESWICK (Vice-Chairman of the Bolton Gas Committee) replied on behalf of the Committee, and urged the members to back up the work of the British Commercial Gas Association, both at their own works and in the town they represented.

Mr. W. J. SMITH also replied, and referred to the efficiency and team work of his staff. He mentioned particularly the importance of students who were taking up their studies under the Institution's Education scheme, to make themselves more fully acquainted with the first principles of Engineering and Chemistry.

PRESIDENTIAL ADDRESS

of C. H. BAMBER, B.Sc., of Bolton.

Almost every gas-works nowadays uses electricity in some way or other for power, or for lighting in dangerous situations. Yet how many officials in the gas industry have more than a rudimentary knowledge of electricity?

During the past fifteen years I have had experience of many types of electrical plant for light, power, and heat in chemical works, coke oven plant, and gas-works. I want to consider and describe here my observations and conclusions drawn from the study of such plant. Let us take for a start the source of supply of current, and consider the reasons for choosing a certain type. There are two kinds possible—direct and alternating current. The difference between these should be thoroughly understood. Most gas-works use direct current. Why has this been chosen? Usually it is a relic of two things. Either many years ago the works had of necessity to generate its own current as there was no public supply, or the local supply was direct current. Where one has to generate one's own supply, direct current is more suitable for small generating plant, particularly for slow-speed generators direct coupled to gas engines. This was the choice made in those days. A continuous supply of current was not usually required, but a reliable supply for periodical use at charging and discharging times. The question of reliability was largely responsible for the gas-works generating its own supply. Early public supplies were very uncertain, and liable to fail for long periods at a time. Many are still uncertain, although the reliability is infinitely greater than it used to be. On the whole, it is, I think, better for a works to generate its own current, although a stand-by can be arranged for from a public supply, and hence save the duplication of generators.

Take first the question of voltage with a D.C. supply. Usually, if it is a public supply, 100-110, 200-250, and 400-500 volts will be available—sometimes all three, sometimes only one. If we generate our own current, what voltage shall we choose? Usually, the higher the voltage, the more economical is our supply in use. Low voltage, with its consequent high current values, means heavier and more expensive cables. Hence, on this account alone, one would choose the highest voltage possible. But there are other things which influence our choice. High voltage means a higher standard of insulation both in cables and in apparatus. This is difficult to maintain on a gas-works, but can be done at a price. Again, if lighting is contemplated, as for hand-lamps, in purifiers, &c., 250 volts is the maximum permissible by the Board of Trade. High voltages have other dangers also. On the whole, the best choice is the 200-250 volts supply, although where the 400-500 volt supply is available also, as in the case where a supply company is using the three or five wire system, one may take the full 400-500 volts for power and 200-250 from the neutral and one outer for other purposes. For own generating, undoubtedly 200-250 volts is most generally considered suitable.

ALTERNATING CURRENT SUPPLY.

For home generating, except on very large works, alternating current is not likely to be considered. On very large works, especially completely new works where old motors, &c., have not to be utilized, the use of alternating current is worth consideration.

The tendency on modern works is to employ high-speed generators driven by steam turbines which derive their power from waste-heat steam. Now D.C. generators for higher voltages than 110 volts working at such high speeds as 3000 r.p.m. —quite a common speed for modern steam turbines—are not satisfactory. Insulation of the armatures is difficult to main-

tain, especially in a dusty situation. Commutation is difficult at these speeds, and much heat is generated at the commutators and brushgear. These have of necessity to be larger. Large-diameter commutators are needed to accommodate the necessary segments and the copper to carry the heavy currents. Large brush contact area is also necessary. Smaller diameter would, of course, be better if speed only had to be taken into account. There would be less frictional losses and less danger of bursting. Reducing the number of segments only leads to flashing over. Voltage of supply is, on the other hand, not so important in the case of A.C. supply as it was with D.C. Static transformers can be used to transform up or down to any suitable voltage either for the whole works or for any one section. Such transformers have an efficiency of well over 95 p.ct. in large sizes. Hence generators can be arranged to run at the high speeds above mentioned with great reliability if generating A.C. The voltage supplied to the rotor which takes the place of the armature in the D.C. machine can be quite low—say, 25—and is supplied by two slip rings and simple brushes. The stator in which the generated current is induced is a stationary portion of the plant, and insulation is fairly easy to arrange and maintain for any reasonable voltage. Thus I think that for a very large modern works the use of A.C. is well worth consideration.

The use of A.C. as A.C. to supply motors on a gas-works

THE PRESIDENT,

CECIL H. BAMBER, B.Sc. (Hons.).

Mr. Bamber was educated at Rivington and Blackrod Grammar School, and later at Victoria University, Manchester, where he took the Degree of Bachelor of Science with Honours in Chemistry at the early age of 19. He took up his first appointment as a Research Chemist with a firm in Scotland, working on the carbonization of peat. During the war he was engaged on large-scale research into the manufacture of high explosives at H.M. Factory, Oldbury, for about two years. From there he proceeded to the position of Chief Chemist to the Marley Hill Chemical Company at their coke works and sulphuric acid plant, near Newcastle-on-Tyne. After about three years' experience at these works, he took up the position of Works Superintendent and Technical Assistant to the Bolton Corporation Gas Department in May, 1920.

needs to be understood. Early types of A.C. motors were not very suitable. Their chief fault lay in their poor starting torque and the very small range of speed regulation. The simple squirrel-cage induction motor has a very poor starting torque and will not start under very heavy load. The single phase type is not self starting except with special apparatus. Even the simple wound rotor type had a very small range of speed and poor starting torque. Recent improvements, however, in motors of this type in the rotor windings and in their switch gear have made these motors more suitable for gas-works use, better speed regulation and much greater starting torque being obtained. In general, A.C. motors are more robust than D.C. motors, simpler in construction, have no commutators (just slip rings, usually three), and their brush gear is of the simplest type. The stator to which the power is supplied is stationary, and insulation does not offer the same difficulty, especially in a dusty situation. Our sister industry, the coking industry, uses A.C. on a large scale, and has proved its suitability over long periods.

MOTORS AND SWITCHGEAR.

I would like now to mention the duties performed by electricity on a gas-works, and demonstrate where possible the reasons for choosing certain types of motor, switchgear, &c., for particular services. The duties to consider are very varied. Take coal and coke handling plant. We have wagon tippler, coal crusher, coal and coke elevator, charging and discharging machines, coke conveyors, electrically driven coke trucks, telphers, screens, &c. When discussing these one must consider motor and switchgear together. Many times the type of switchgear is as important as the motor itself. Much of the above plant operates continuously, such as coal crushers, elevators, conveyors, screens, &c. For these duties constant-speed motors capable of starting up under full load must be selected. Compound-wound D.C. motors with standard starting switchgear of ample dimension are quite suitable for this purpose, and are in regular use. Up to about 20 H.P., squirrel-cage A.C. motors with starting switchgear of "Star Delta" or "Auto-Transformer" type are suitable. For higher powers the wound rotor type with suitable rotor starting resistances is quite satisfactory. It pays to have all motors totally enclosed for gas-works use, where so much dust is to be met with. This necessitates a larger size of motor. The reason for this, of course, is that there is less heat carried away from the motor than in an open ventilated type by air circulation. Such enclosed motors usually have a fan fitted to the armature, and this circulates air inside the machine, driving the heated air against one end of the casing, where it gives up some of its heat. The casing is ribbed to help radiation. Of course, the heat carried away is less than from an open type motor, and the machine is necessarily larger. The extra cost is, however, amply repaid by the greater reliability. The freedom from dust, especially coal and coke dust, in the armature is a preventive against short-circuits and breakdown of insulation.

Other types of plant may require different types of motor. For traction work undoubtedly the best type is the series-wound D.C. motor. This has a very high starting torque and permits of simpler speed regulation and switchgear than any other type. Such motors are fitted to telphers for travelling, coke bogies, electric shunting locomotives, the travelling motors of retort charging machines, &c. This type of motor has a very robust field winding through which all the armature current passes. A very strong field is generated when the heavy starting current passes and consequently gives a high starting torque. It is used for practically all traction purposes. It is quite unsuitable for constant speed work as its speed varies inversely with the load, and if the load is suddenly removed the motor will race and damage itself. A.C. motors are not ideal for traction work, but can be, and are, used particularly at coke works and blast furnace plant. Either three-phase wound rotor machines with starting resistance for the rotor are used, or a special type of series-wound motor similar to the D.C. motor, but with laminated field magnet, may be worked from single phase A.C., the supply for which may be taken from one phase of a three-phase circuit. The starter is similar to that of the D.C. machine. The three-phase motor will, of course, require three trolleys to pick up its supply, whereas the single phase may be used with one trolley and earth return.

Telpher winding motors, hoist or lift motors, charger motors, and motors for such duty are usually compound wound D.C. machines. Shunt-wound D.C. motors are not usually used for gas-works purposes; in fact, they are not used much for power in any works. They slow down somewhat as the load increases, and their starting torque is poor. Practically all D.C. machines are fitted with inter-poles. The purpose of such poles is to minimize sparking at the commutators. There is, theoretically, only one correct position for the brushes for a specific load, and this moves round the commutator as the load increases due to field distortion by armature reaction. By opposing the magnetic field set up by armature reaction these inter-poles prevent distortion of the magnetic field and virtually keep the optimum position for the brushgear in one place. It is important to see that they are correctly connected.

MAINTENANCE OF MOTORS AND GENERATORS.

While discussing motors we should consider the maintenance of these and the generators. Too often they are neglected, and breakdowns occur which could have been avoided. Generally speaking, an electric motor is a very reliable source of power, but in some respects it is delicate. Particular attention should be given to bearings. If these are of the journal type, using the ring oiling system, the oil should be changed at least weekly, and oftener in a dirty situation. A very large number of failures of electric motors are due primarily to failure of the bearings causing the armature to foul the poles, generate heat, and cause a burn-out or mechanical damage to the armature, binding wires, and ultimate bursting of the coils. If the bearings as in modern machines are ballraces or roller bearings only a little grease is required from time to time (say) daily unless the machine runs very hot. Too much oil or grease should be avoided in any type of motor bearing. Despite the

fitting of oil thrower rings on the shaft such excess oil ultimately gets to the commutator and windings causing damage to the insulation and serious sparking with consequent burning of the commutator and excessive wear on the brushes. Oil on the commutator or windings is emphatically dangerous. Commutators and slip rings should be kept clean. The mica between the segments should be kept recessed or undercut below the segments. This is to avoid the tendency for the copper, being softer, to get below the mica by wearing away faster. The result of such a state is excessive sparking caused by the high mica lifting the brush as it passes under it and breaking the circuit momentarily.

Commutators should be kept true and level. The brushes should not lift in the holders during running, as would be the case with a commutator out of the true. If this occurs the machine should be dismantled and the commutator trued up in a lathe. Generally in the case of motors this should not be required very often—say, yearly. The brush pressure should be firm but not more than necessary to prevent sparking, and a suitable grade of carbon should be selected. Soft carbon brushes are expensive, but they are required on high-speed generators and motors. They wear away rapidly, as also does the commutator on such machines. Commutation at high speeds calls for greater area of brush than at slower speeds for the same current carrying capacity. Machines should be periodically cleaned of all dust in the windings by an air blast and a regular test taken with the Megger for insulation resistance. If this is low a good stoving and varnishing will usually put it right if caught in the early stages. Neglecting to do this will cause serious breakdown before long.

Switchgear and Meters.

Switchgear and meters are another side of the question of the use of electric power in a gas-works. In such I include main switches and circuit breakers, all smaller switches and motor starting switchgear. The main switches from the generators in the case of the size of plant used on a gas-works are usually of the quick break knife switch pattern on the switchboard itself, the voltage and current not being high enough to necessitate their being placed in isolated cubicles. They should be of ample dimensions and quick in action. Suitable paralleling switches should be fitted so that two or more machines can be run together and feed into the same busbars.

It is important to have reliable meters on the board, and in the case of D.C., these should be of the moving coil type, or at any rate polarized, so as to show the polarity of an incoming machine to be paralleled. The polarity of a machine can get reversed, and if one attempts to parallel machines of opposite polarity, they won't—and out comes the circuit breaker at least, and further damage may result. A.C. machines can be run in parallel and even synchronized and paralleled with an outside source of power. Suitable synchronizing indicators will have to be fitted to enable this to be done. The governing of generators in parallel is important. If this is not efficiently done the load will not share itself evenly between the machines.

Main Circuit Breakers.

The question of main circuit breakers is important, and reliable breakers of the double-pole type are advisable. These should be set for (say) 100 p.ct. overload above the normal output of the generator, and have a fair time lag. One does not want the breaker out every few minutes on account of a temporary overload due to starting several motors at once, but one does want protection against short circuit or excess overload. A reasonable time lag will arrange this nicely. The time lag is usually arranged by oil dashpots; and it is important to see that these are kept filled with oil. As a rule, fuses are sufficient protection on separate lines from the main board for a medium sized works. For the very large works it will be better to have circuit breakers in the branch circuits, so as to have the main breakers remain in except for sheer emergency. The main breakers will be set for a greater time lag than those in the branch lines.

The motors will either be fed from junction boxes from a main cable supplying all the works or they may have their own feeders direct from the switchboard. Alternatively, all the motors in one section of plant—say, one retort house—may be supplied from one main feeder direct from the board, and those in another section by a separate feeder, and so on. Main switches, ammeters, and fuses would be placed on the board in each feeder circuit. This allows of isolation and measurement of the current taken in each circuit—a very desirable piece of information. Finally, each motor may be fed direct from the busbars on the board, and have its own meter and main switch on the board. This last system, while no doubt ideal, is only practicable where the generating set is centrally situated in a compact works, and even then it is very extravagant on cable.

All motor starters except those for very small machines should be fitted with ammeters, despite any meters that may be on the main switchboard. It is often highly important to be able to see at a glance, without going to the main board, what current is being taken. Starters should be fitted conveniently close to the motors. They will vary considerably in type according to the kind of motor and whether for D.C. or A.C. Several details are, however, common to all types. They should all be fitted with no-volt and overload releases which bring the starter back to the off position either on failure of supply or excessive overload; and, what is most important, these safety devices must be kept in order and tested frequently. They protect the motor from damage. The no-volt release is designed to cut the motor out of circuit on failure of supply so that damage will not occur when the current comes on again. The overload release explains itself, I think. Only too often have I seen one or both either tied up or wedged in position. They have, no doubt, caused trouble through not having been maintained in good order. Such a condition is highly unsatisfactory and dangerous. Fuses have a habit of being replaced in heavier sizes, and a fuse cannot be trusted to give the protection a no-volt release or overhead release gives. Fuses take time to blow, also, whereas, despite a necessary time lag, the electrical safety device can give quicker and smarter protection. I would like to emphasize the advisability of a periodic inspection of all fuses.

Motor starters for motors driving plant over an extended area and height such as coal elevators, should be fitted with switches at intervals over the length of the conveyor which will stop the motor. These short-circuit the no-volt coil, and bring the starter to the off position. Such switches are usually of the push button type, and should be of substantial design, totally enclosed, made for the supply voltage, and frequently tested to prove they are in working order. A good practice is for the attendant when closing down to stop the motor by means of one of the push buttons using a different one each time.

Starters for such motors as lifts, coke hoists, &c., are of a special type. They are automatic, and the arm is carried over the rheostat studs by a solenoid which comes into action and starts the motor whenever the circuit in the solenoid is closed, say, by the switch at a lift gate. The speed of the arm is limited usually by damping in the form of an oil dash pot. All lifts should be fitted with switches on the gates, so arranged that if any gate is open the circuit is broken and the motor cannot be worked. Such switches are subject to much wear and should be regularly inspected and adjusted. The actual type of switchgear to use for any particular duty is best left in the hands of a firm of switchgear makers. Many firms specialize in this work alone. The only point I would emphasize about gas-works switchgear and motor starters is that they should be robust, as fool-proof as possible, and capable of withstanding much mishandling. All motor starters should be effectively earthed, as also all motors and generators, quite irrespective of the fact that one side of the mains themselves may be earthed. The Board of Trade insists that all electrical gear be earthed. A good earth can usually be got on a gas-works by connection to a water pipe near the ground level. Do not use steam or gas mains for this purpose. Failing a suitable earth connection, resort must be had to burying a large copper plate, but this is not often required, although the generators themselves are sometimes earthed in this way.

The cables themselves need some consideration. I think there is little doubt that the modern type of lead covered, braided and steel armoured cable, using oil impregnated paper insulation, leaves little to be desired. Care must be taken to use the correct bitumen-sealed boxes for connecting to this cable so as to keep in the oil and keep out moisture. I do not care for buried cable on a gas-works. There is usually much ground containing ashes and other corrosive matter making buried cable risky. Where possible, cables can be run on runner boards suitably fixed, or slung from building to building from steel aerial cables well anchored at the ends. Aerial cables of bare wire have been used and also braided V.I.R. cables, but these are not to be advised. All lighting cables, of course, should be in conduit where possible, and the conduit should be of the screwed type and effectively earthed.

Electric Lighting.

Electric lighting is desirable in some portions of a gas-works, such as in the purifiers, and care should be taken in the type of fittings used. Open lamps are usually a failure. Apart from danger due to breakage, the holders and even the lamp bases corrode away rapidly. Totally enclosed substantial C.I. lanterns are best, and if we do not wish to have frequent lamp renewals we must not put too large a lamp in the lantern. Electric lamps generate heat, of course, and in an enclosed lantern this is not carried away freely. Lamps get overheated, and the filaments reach a higher temperature than that for which they are designed. All lighting switches should preferably be of ironclad pattern, or, alternatively, if of the tumbler pattern, should be of bakelite or other insulating material wherever the floor is of brick, stone, concrete, earth, or steel.

All portable lamps obtaining their supply from the mains must be of the wire-cage Home Office type, and the cable used is best if of the "cab-tyre" rubber covered kind. This stands up well to mishandling, even to the extent of lying in water or having a wheelbarrow run over it—not too frequently, of course.

Portable motors, such as electric drills, grinders, &c., must be fed by three-core cable, the third core being used to earth the machine. The practice of running such machines from a lampholder is to be deprecated very strongly. Electrocution is

possible even on 200 volts, and a portable drill not efficiently earthed and held in the hand is dangerous if insulation fails.

While on the subject of cable and wiring, the question of earthing one main of a D.C. supply is worth some consideration. If a public supply is used no choice is possible, as one main will be earthed to start with; but if generating our own supply we can please ourselves. Where we are using electric traction unless one supply main is earthed we shall require two trolleys. This is not serious, except for their maintenance, if there are no crossings in the track. These cause trouble in that one has trolley wires of opposite polarity crossing one another. This necessitates a "dead" crossing and a break in the motor circuit as the trolley passes the crossing. A further trouble is the fact that under some circumstances a trolley coming off the wire at one of these crossings may short circuit both mains and bring the "breaker" out. However, such difficulties can be overcome, as can be observed from the trackless electric trams running satisfactorily up and down the country. Where a large amount of reinforced concrete and steel buildings are being used it is said that there is less danger from electrolysis where one main is not earthed and traction apparatus does not use a "track return" and single trolley. It is very doubtful whether any advantage is gained and whether the complication is worth while. Where no earth is used, especially on a gas-works where perfect insulation is difficult, and dusty situations abound, one often finds a heavy leakage of currents to earth, and the ironwork of a building may be carrying these and, what is more, not always in the same direction. It may be anodic with respect to the earth one day and cathodic another. With carefully bonded track and suitably earthed return main, the single-trolley system, in my opinion, need give one little anxiety with regard to electrolysis, and any leakage currents are definitely in one direction and can be arranged to be in the least harmful way.

Battery-Driven Locomotives.

Speaking of traction brings me to a further system of traction —that of small battery-driven locomotives. The possibility of using these on a gas-works is worth consideration in some respects and not in others. All troubles with trolleys and trolley wires, especially in such awkward situations as under a setting, cease. Also batteries form a useful means of storage for the power derived from waste-heat steam at night. Often waste-heat boilers are blowing off at night when there is only a small load. Battery locomotives can be charged at such times. Against these advantages one must weigh the cost of the battery and the fact one has to have spares. The cost of a battery may be as much as £1000 for a shunting locomotive. It is a delicate piece of apparatus, and, despite what the manufacturers may say, can be permanently damaged in a few days through carelessness. Where such batteries are used a skilled man only should attend to their charging and maintenance. On the whole I think that battery-driven traction plant is not very suitable for gas-works use, and I prefer the trolley type.

Storage batteries of small type will undoubtedly be used by most works for hand lamp use and other light duties. I would like to mention here that more satisfactory service from these will be obtained if their maintenance and charging is put in the hands of one person who alone will be responsible for the regulation of acid strength, charging, renewal, &c. Have some spare cells, and let every cell be fully discharged as well as charged, and do not overcharge. Many batteries are ruined by overcharging, and I have found that where anyone is allowed to put batteries on charge they are often overcharged for hours, and the acid not maintained at any specific level or strength. Since making one man responsible for this duty at our own works we have noted a very marked improvement in the life and capacity of the cells. I suggest that the laboratory is the best place to deal with small cells.

I hope by my notes to have increased your interest in the generation, supply, and use of electrical energy on a gas-works. I would urge all Juniors to take a keener interest in this subject.

Mr. H. B. Knowles (Lancaster) moved, and Mr. Carter (Liverpool) seconded, a vote of thanks to Mr. Bamber for his Presidential Address.

Mr. Bamber briefly replied.

REGISTER OF PATENTS

Recovery of Ammonia.—No. 334,619.

The Gas Light and Coke Company, Hollings, H., Pexton, S., and Hutchinson, W. K., all of 84, Horseferry Road, Westminster, S.W. 1.

No. 17,914; June 11, 1929.

According to this invention, a process of recovery of ammonia from coal gas, of the type in which the gas is scrubbed with a weak ammoniacal liquor—for example, such a liquor derived from a previous cooling operation upon the gas under treatment—is characterized by treating the ammoniacal liquor with a gas containing carbon dioxide and substantially free of ammonia, so as to increase its capacity for scrubbing the gas.

The weak ammoniacal condensate from the primary condensers is deficient in carbon dioxide and contains caustic ammonia, and the ammonia-scrubbing capacity of the liquor is increased, according to this invention, on account of the fact that the carbon dioxide introduced into it unites with the caustic ammonia in the liquor to form a soluble ammonium compound or compounds which have a lower partial pressure of ammonia than caustic ammonia. Thus, according to the amount of carbon dioxide dissolved in the liquor, the ammonia content of the latter is converted into normal ammonium carbonate or ammonium bicarbonate. It is preferred to dissolve such quantity of carbon dioxide in the liquor as will result in conversion of the ammonia content of the liquor completely, or substantially so, into the bicarbonate form, since the partial pressure of ammonia in the case of bicarbonate is lower than that in the case of the normal carbonate.

In a gas-works there are usually several convenient sources of carbon dioxide, and this invention provides a means of utilizing hitherto waste carbon dioxide. Any convenient source of carbon dioxide may be employed, however. For example, flue gas may be used provided it has been sufficiently cooled; or carbon dioxide derived from the ammonia stills during the distillation of ammoniacal liquor in the manufacture of ammonium sulphate; or carbon dioxide recovered from the gas which has been treated as above for the removal of ammonia from it, or from water gas, by a process of washing the treated gas or the water gas with potassium carbonate solution and heating the potassium bicarbonate solution so formed. This process of recovering CO_2 by washing the gas with potassium carbonate forms an integral part of certain known processes—for instance, the Petit process for removing hydrogen sulphide from gas, and the Athion process for removing carbon bisulphide from gas—and the carbon dioxide from these processes might also be used advantageously for the purpose of this invention.

The temperature in the carbonating plant should be as low as possible and should preferably not exceed about 60° F. Otherwise, the liquor will not take up sufficient carbon dioxide for the purposes of the invention. There will usually be a gaseous effluent from the carbonating plant, containing a small proportion of NH_3. This ammonia may be recovered by introducing the effluent from the carbonating plant to the stream of gas under treatment at a point situated between the primary condenser and the ammonia washers.

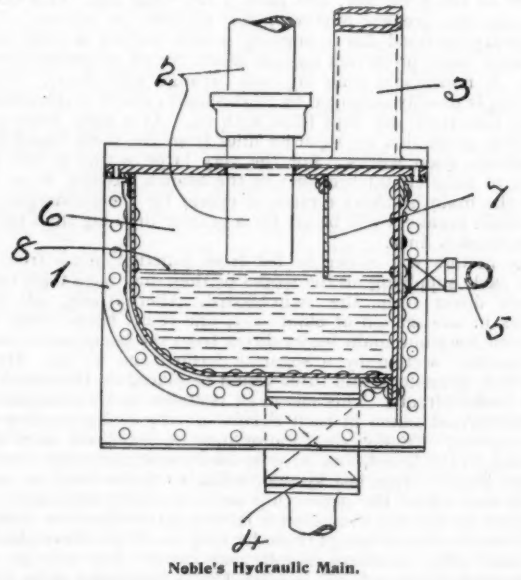
Hydraulic Mains.—No. 334,705.

Noble, J. H., of Chester.

No. 26,503; Aug. 31, 1929.

In the accompanying diagram, a hydraulic main is indicated at 1, a dip pipe forming one of many at 2, and the gas offtake at 3.

An outlet for tar, controlled by a valve, indicated at 4, leads to a tar tower. In the illustration a valve-controlled balance pipe in



Noble's Hydraulic Main.

connection with the tower is shown at 5, which pipe allows a common level of liquid between the main and the tar tower to be maintained.

The space marked 6 forms what is termed a pressure-equalizing chamber. Between the dip pipes 2 and the gas off-take 3 is a division or plate 7, which is permanently sealed by having its lower edge always below the level of the liquid in the main, the lowest level of which is indicated at 8 in the illustration.

The dip pipes have their lower extremities situated above the liquor level referred to under normal conditions, and during gas making periods; but when the retorts require to be charged, the pipes are assumed to be closed by valvular means not shown but well known. As all the dip pipes from the various retorts of the set involved terminate at the common chamber 6, the gas pressures in the retorts combine to form one uniform pressure.

Filters for Gas Burners.—No. 334,307.

BURTON FOUNDRY COMPANY, LTD., and CAMPBELL, D. F., both of Burton-on-Trent.

No. 18,523; June 17, 1929.

This invention relates to gas burners for use in connection with fires, cookers, and other appliances, the object being to prevent clogging of the burners and to provide for easier cleaning or removal of such extraneous matter as may accumulate. A filter of wire gauze is provided, and is incorporated within the burner tube inlet pipe where the gas will pass through it before entering the burner mixing chamber, so that when cleaning is necessary there will be only one filter to be removed.

Gas Fires.—No. 334,665.

SOCIETE GAZ & CHALEUR, and DAMIEN, E., both of Paris.

No. 22,290; July 19, 1929.

This invention relates to gas radiators in which a row or rows of burners raise the temperature of refractory heating elements to incandescence, the hot gases produced circulating in an air heating chamber across which are arranged tubes, which form passages through which passes the air to be heated. The invention comprises a gas radiator provided with heating elements and an air heating chamber, in which the plates forming the baffles of the recovery box slide between ribs on the walls of the box, which box also carries ribs for the support of a refractory back plate behind the heating elements, and lugs as securing means for the top and bottom of the recovery box.

Applications for Patents.

[Extracted from the "Official Journal" for Sept. 24.]

Nos. 27,434—28,191.

JUNKERS, H.—"Gas heating stoves." No. 27,777.
KOPPERS COMPANY.—"Floors for coke-quenching cars." No. 28,070.
LINGNER, G.—"Gas-heated devices for heating liquids." No. 27,814.
MARSH, R. G.—"Gas-heated geysers." No. 27,722.
ROGERS, R. J.—See Marsh, R. G. No. 27,722.
WHEELER, H. J.—"Geysers." No. 27,832.

[Extracted from the "Official Journal" for Oct. 1.]

Nos. 28,192—29,034.

GAS CHAMBERS AND COKE OVENS, LTD.—"Coke oven charging larries." No. 28,750.
HELPS, G.—"Gas cookers." No. 28,379.
KOPPERS COMPANY.—"Valve mechanism for coke ovens." No. 28,774.
RYDER, F. E.—"Lifts for waterless gasholders." No. 28,421.
SHAW, W.—"Gas cookers." No. 28,208.

Legal Intelligence

Nottingham Gas Official Charged.

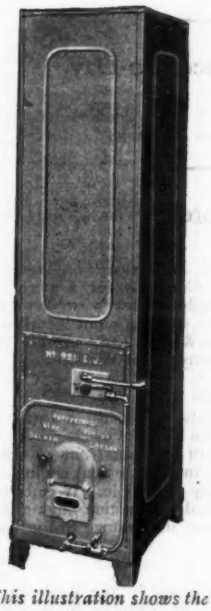
Further developments in regard to this case were indicated on Wednesday, Oct. 8, when Leonard W. G. Ball, 42, of the Nottingham Corporation Gas Department, and John Ernest Allen, 47, a local builder, were brought up in custody charged on remand with stealing £129 and £132 13s., the moneys of the ratepayers. It was stated at a previous sitting of the Court that the alleged offences arose out of the purchase from Allen of certain timber for the use of the Department, which it had been discovered had not been delivered although paid for by the Corporation.

Mr. H. W. Ward, Barrister, of Birmingham, stated that a new charge, one of conspiracy, had been now preferred against the prisoners. Further developments had taken place, and he applied for a further remand not exceeding a week.

Applications for bail were opposed by the police and again refused.

A third arrest was made on Oct. 10. This was of Walter Ball, described as a manager, who was brought before the Magistrates on Oct. 11, charged with conspiracy with the other defendants. He denied the charge; and bail, which was not opposed by the police, was granted.

THE HAIRDRESSING FAIR OF FASHION
EMPIRE HALL, OLYMPIA.
November 5th—13th, 1930.



This illustration shows the Latest in Thermal Storage, cellulose enamelled.

HOT WATER.

A Potterton installation with "VICTOR" Automatic Thermal Storage apparatus yields an abundant supply of hot water with the greatest flexibility whenever the demand occurs, and at other times, both day and night, maintains the water HOT with a consumption of 1·7 cu. ft. gas per hour—less than 2d. per day.

A working exhibit is available for your inspection at Stand No. 22, Ground Floor.

THOMAS POTTERTON (HEATING ENGINEERS) LTD.
Cavendish Works, Ravenswood Road, Balham, London, S.W. 12.
Telephone: Streatham 2052/3. Telegrams: Potterton, Bal, London.

GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The Stock Exchange opened the new Account last week with quiet conditions in most markets. The gilt-edged section continued to dominate the situation, and at the commencement 5 p.ct. War Loan touched 104$\frac{13}{16}$; but by the end of the week prices of British Funds lost ground, and considerable weakness was displayed in most other sections. The Government's issue of the new 4 p.ct. Treasury Bonds to repay the 4 p.ct. Tax Compounded War Loan met with a gratifying response. Over £116,000,000 was applied for, and tenders to the amount of £105,000,000 were accepted, the average price obtained being £100 11s. 6·89d.

There is no cause for pessimism, however, with conditions in the Gas Market. Prices in the majority of cases remain firm with a general tendency to harden, as is illustrated by comparing the highest prices of transactions recorded last week with those of the previous week, though in several instances the quotations have not been altered. Improvements in ordinary stocks last week occurred in Bristol 5 p.ct. maximum at the local Exchange by ½ point to 90-91, and Liverpool 5 p.ct. a further ½ to 95-96, making 4½ points during the past three weeks. Debenture stocks were again in demand, and several increases were recorded—viz., British 5 p.ct., 1 point to 95-98; Gas Light and Coke 5 p.ct., 1 point to 100-103; business in the latter security being done at 102, the highest price recorded this year. Wandsworth 5 p.ct. and 5 p.ct. preference also gained a point each to 98-101 and 90-93 respectively. Apart from *ex* div. reductions, European ordinary fell 3 points to 105-115, and (at the local Exchange) Newcastle £1 units eased 3d. to 15s. 6d.-16s., and the 3½ p.ct. debenture ½ to 65¾-67¾.

With regard to the working agreement between the South Metropolitan Gas Company and the Commercial Gas Company, referred to in this column last week, it is learned that the applications from the Commercial stockholders to exchange their holdings exceeded the amount required—viz., £691,093—and that the list was closed at 4 o'clock on Thursday of last week.

A parcel of £1153 of the Watford and St. Albans Gas Company's 3½ p.ct. standard stock (last rate of dividend 6¾ p.ct. per annum) and two 5 p.ct. mortgage bonds of £100 each have recently been sold locally at a public auction by order of the executors of a deceased stockholder. The standard stock realized from £115 to £116 p.ct., and the bonds £96 each.

Coal Markets.

There appears to be little change from week to week in the markets and, at any rate as far as export is concerned, business is still held up pending publication of the marketing schemes. It is difficult to see how competition with, for instance, Polish coal is to be assisted, as prices there are far below those of equivalent English qualities.

Reports generally of inland trade show that there has been some improvement in demand due to seasonal conditions, and this has been noticeable especially in the Newcastle market for gas coals. The demand is still far below normal, and prices unchanged, but there has been more movement in the past week than for some time. Quotations are at about 15s. to 15s. 3d. f.o.b. for Wear specials, 14s. 6d. to 14s. 9d. for best qualities (Holmside, Boldon class), and 12s. 6d. to 13s. 3d. for seconds. With the removal of the export subsidy, the official export prices for Yorkshire screened gas have risen to 16s. 6d. to 18s.

Gas coke trade is good, and business for both prompt and forward is brisk at about 21s. 6d.

Current Sales of Gas Products.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Oct.* 13.

There is no change in the values of tar products, which remain as follows:

Pitch, 47s. 6d. per ton f.o.b.

Creosote, for export, 6d. to 6¼d. per gallon f.o.b.

Pure toluole, about 2s. 2d. per gallon; pure benzole, 1s. 9d. to 1s. 10d. per gallon; 95/160 solvent naphtha, 1s. 5d. to 1s. 6d. per gallon; pyridine bases, about 3s. 9d. per gallon.

All these prices are *ex* sellers' works.

Tar Products in the Provinces.

Oct. 13.

The average prices of gas-works products during the week were: Gas-works tar, 20s. to 24s. Pitch—East Coast, 46s. f.o.b. West Coast, Manchester, Liverpool, Clyde, 46s. f.o.b.* Toluole, naked, North, 1s. 6¼d. to 1s. 7¼d. Coal-tar crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 2¼d. to 1s. 2½d. Heavy naphtha, North, 11d. to 1s. Creosote, in bulk, North, liquid and salty, 3¼d. to 3⅜d.; low gravity, 1¼d.; Scotland, 3¼d. to 3⅜d. Heavy oils, in bulk, North, 5¼d. to 6d. Carbolic acid, 60's, 1s. 4½d. to 1s. 6d. Naphthalene, £10 to £12. Salts, £3 to £5, bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port, it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Oct.* 11.

Values continue easy, and trading is on a limited scale. Pitch inquiries are quite numerous, but very few orders are being placed in this area.

Pitch.—Continental buyers are not showing much interest at quoted price of 45s. to 47s. 6d. per ton f.o.b. Glasgow. The home market is dull at about 45s. per ton *ex* makers' works.

Refined tar to Ministry of Transport Specification is stationary at 3d. to 3¼d. per gallon naked at works.

Creosote.—Moderate quantities are being placed at to-day's prices. B.E.S.A. Specification is 2⅞d. to 3¼d. per gallon; low gravity, 3d. to 3¼d. per gallon; and neutral oil, 3d. to 3¼d. per gallon—all in bulk quantities f.o.r. works.

Cresylic.—Stocks are rather high and orders are scarce. Pale 97/99 p.ct. is 1s. 6¾d. to 1s. 7¾d. per gallon; dark, 97/99 p.ct., 1s. 5¾d. to 1s. 6¾d. per gallon; and pale, 99/100 p.ct., 1s. 8¾d. to 1s. 9¾d. per gallon—all in buyers' packages f.o.r.

Crude naphtha.—Production is small, and available supplies command about 4d. to 4½d. per gallon *ex* works.

Solvent naphtha.—The position is unchanged with 90/160 quoted at 1s. 2½d. to 1s. 3d. per gallon, and 90/190, 1s. to 1s. 0½d. per gallon.

Motor benzole.—Meantime the value has settled at 1s. 5d. per gallon in bulk.

Pyridines remain without interest. 90/160 is 3s. to 3s. 3d. per gallon.

Benzole Prices.

The following are considered to be the market prices at the present time:

	s. d.	s. d.	
Crude benzole	0 8	to 0 9	per gallon at works
Motor "	1 3½	" 1 4½	" " "
Pure "	1 8	" 1 9	" " "

Contracts Advertised To-Day.

Retorts.

The Cowes Urban District Council invite tenders for resetting one bed of through retorts. [Advert. on p. 182.]

Trade Notes.

Tully Plant for Kelty and Wemyss.

Messrs. Tully, Sons, & Co., Ltd., of Newark-on-Trent, have received an order from the Kelty Gas Company for a mechanically operated Tully gasification plant, complete with waste-heat boiler. The plant will serve as a duplicate to the existing plant installed some eleven years ago. Messrs. Tully, Sons, & Co., Ltd., are also installing one of their plants at the West Wemyss Gas-Works.

Crossley Compressorless Diesel Engines.

Messrs. Crossley Brothers, Ltd., have published a catalogue of their compressorless Diesel engines. The Crossley enclosed type compressorless Diesel vertical engine is built in sizes from 30 B.H.P. to 360 B.H.P., and represents a distinct advance in vertical engine design. It is entirely enclosed and yet extremely accessible. It embodies all the principles of the highest-class internal combustion engine practice with many new innovations of paramount importance to the user.

Wellman-Galusha Gas Producers.

A new catalogue has recently been issued by the Wellman Smith Owen Engineering Corporation, Ltd., of Victoria Station House, S.W. 1, describing the "Wellman-Galusha" gas producer which the firm have just placed on the market for the gasification of low-grade fuels, such as coke breeze, anthracite beans, &c. In this producer the grates have no perforations through which extremely fine fuel can be wasted, and the elimination of water seals makes it practicable to carry blast pressures of several pounds if necessary to overcome the resistance of very small fuels.

STOCK AND SHARE LIST.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Oct. 10	Rise or Fall on Week.	Transact'ns Lowest and Highest Prices During the Week.
£			% p.a.	% p.a.				
171,978	Stk.	Aug. 14	5	5	Aldershot 5 p.c. max. C.	73—78	..	..
522,992	,,	,,	4	4	Do. 4 p.c. Pref.	68—71	..	..
1,551,868	,,	Oct. 9	7½	7½	Alliance & Dublin Ord.	93—96*	−3	94½—97½
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	60—63	..	62—63
522,655	,,	Aug. 28	7	7	Barnet Ord. 7 p.c.	106—109	..	..
300,000	1	Apl. 24	1/4½	1/7½	Bombay, Ltd.	16/- —18/-	..	16/3
174,500	10	Aug. 14	9	9	Bournemouth 5 p.c.	14—15	..	14⅜—14⅞
500,050	10	,,	7	7	Do. B 7 p.c.	12½—12⅝	..	12½—12⅝
439,160	10	,,	6	6	Do. Pref. 6 p.c.	10½—11¼	..	..
50,000	Stk.	June 26	3	3	Do. 3 p.c. Deb.	55—58	..	57—58
162,025	,,	,,	4	4	Do. 4 p.c. Deb.	74—77	..	..
357,900	,,	Aug. 28	7½	7½	Brighton & Hove 6 p.c. Con.	112—117	..	114
371,880	,,	,,	6½	6½	Do. 5 p.c. Con.	101—104	..	..
1,287,500	,,	July 24	5	5	Bristol 5 p.c. max.	90—91a	+½	..
855,000	,,	Sept. 25	8	7	British Ord.	108—113	..	111½
100,000	,,	June 26	7	7	Do. 7 p.c. Pref.	112—117	..	..
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb.	72—75	..	..
450 000	,,	,,	5	5	Do. 5 p.c. Red. Deb.	95—98	+1	..
100,000	,,	June 26	5	5	Cambridge 5 p.c. Deb.	94—97	..	..
100,000	10	May 22	6	10	Cape Town, Ltd.	9—10	..	..
100,000	10	Apl. 24	4½	4½	Do. 4½ p.c. Pref.	6⅞—7½	..	7
150,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb.	71—76	..	74½—75½
626,860	,,	July 24	6	6	Cardiff Con. Ord.	94—97	..	..
237,860	,,	June 26	7½	7½	Do. 7½ p.c. Red. Deb.	97—100	..	..
157,150	,,	Aug. 14	6½	5	Chester 5 p.c. Ord.	86—91b	..	..
98,936	1	Oct. 9	†2/-	†2/-	Colombo, Ltd. Ord.	32/—34/-*	−1/-	..
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref.	18/—20/-*	−/6	..
609,204	1	Oct. 9	1/9½	1/4½	Colonial Gas Assn. Ld. Ord	16/6—18/6*	−/6	..
296,053	1	,,	1/7½	1/7½	Do. 8 p.c. Pref.	18/—20/-*	−1/-	..
2,073,280	Stk.	July 24	7	6	Commercial Ord.	94—97	..	94½—96
475,000	,,	June 26	3	3	Do. 3 p.c. Deb.	56—59	..	..
787,560	,,	Aug. 14	7	7	Croydon sliding scale	104—107	..	..
453,100	,,	,,	5	5	Do. max. div.	81—84	..	82½—83
842,370	,,	Aug. 14	10	7	Derby Con.	115—125*	..	..
55,000	,,	June 26	4	4	Do. Deb.	65—70e	..	..
209,000	,,	Aug. 28	5	5	East Hull Ord. 5 p.c.	69—71	..	..
1,002,180	,,	Sept. 25	†7g	†4	European, Ltd.	105—115	−3	105—110
18,629,125	,,	July 24	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	18/9—19/3f	..	18/10½—19/3
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	63—65	..	63⅝—64⅝
4,157,020	,,	,,	4	4	Do. 4 p.c. Con. Pref.	78—81	..	79—80
5,602,620	,,	June 26	3	3	Do. 3 p.c. Con. Deb.	60—63	..	61½—62
5,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb.	100—103	+1	100¾—102
161,480	,,	Sept. 11	10	10	Harrogate Cons. 10 p.c. max.	155—160	..	..
82,500	,,	Aug. 28	7	7	Hastings & St. L. 5 p.c. Conv.	97—102	..	..
258,740	,,	,,	5½	5½	Do. 5½ p.c. Con v.	76—81	..	..
70,000	10	Oct. 9	½	10	Hongkong & China, Ltd.	18—14*	−½	..
213,200	Stk.	Aug. 14	6	6	Hornsey Con. 3½ p.c.	88—91	..	..
2,436,594	,,	May 22	10	25	Imperial Continental Gas	330—350	−5	335—353
223,130	,,	Aug. 14	3½	3½	Do. 3½ p.c. Red. Deb.	80—85	..	80—83
285,242	,,	Aug. 14	8½	8½	Lea Bridge 5 p.c. Ord.	123—128	..	..
2,145,907	,,	Aug. 14	6	6	Liverpool 5 p.c. Ord.	95—96b	+½	..
600,000	,,	Sept. 25	7	7	Do. 7 p.c. Red. Pref.	97½—99½b	..	..
165,736	,,	Aug. 28	8	9	Maidstone 5 p.c. Cap.	120—125	..	..
63,480	,,	June 26	3	3	Do. 3 p.c. Deb.	51—54	..	..
75,000	£	June 26	†10	†10	Malta & Mediterranean	5¼—6	..	5⅝
392,000	—	Oct. 1	5½	5½	Metrop'litan (of Melbourne) 5½ p.c. Red. Deb.	88—91*	..	..
675,000	Stk.	May 22	†6	†8	Montevideo, Ltd.	105—110	..	105
2,061,315	,,	July 24	5⅛	5	Newcastle & Gateshead Con.	15/6—16/-d	−/3	..
682,856	,,	,,	4	4	Do. 4 p.c. Pref.	71½—72½d	..	..
691,705	,,	June 26	3½	3½	Do. 3½ p.c. Deb.	65⅞—67½d	−¼	..
169,940	,,	Aug. 28	7½	7½	North Middlesex 6 p.c. Con.	106—111	..	..
396,160	,,	Aug. 14	5	5	Northampton 5 p.c. max.	76—81	..	..
300,000	,,	Apl. 24	9	7	Oriental, Ltd.	108—113	..	110½—112
60,000	£	13 My., '15	—	—	Ottoman	0—½	..	..
205,162	Stk.	June 26	8	8	Plym'th & Stonehouse 5 p.c.	110 115	..	..
424,416	,,	Aug. 28	8	8	Portsm'th Con. Stk. 4 p.c. Std	107—112	..	..
241,446	,,	,,	5	5	Do. 5 p.c. max.	77—80	..	..
186,000	100	June 2	4	4	Primitiva 4 p.c. Red. Deb.	96—99	..	..
677,837	Stk.	July 24	4	4	Do. 4 p.c. Red. Deb. 1911	81—84	..	..
371,495	,,	June 26	4	4	Do. 4 p.c. Cons. Deb.	81—84	..	..
150,000	10	Sept. 25	6	6	San Paulo 6 p.c. Pref.	8½—8¾	..	8¼
1,736,968	Stk.	Aug. 28	6½	6½	Sheffield Cons.	100—103e	..	..
95,000	,,	July 10	4	4	Do. 4 p.c. Deb.	76—78e	..	..
90,000	10	June 5	‡4	‡5	South African	4—6	..	..
6,709,895	Stk.	Aug. 14	7½	5	South Met. Ord.	102—104	..	102½—103½
500,000	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	107—110	..	108½—110
1,895,445	,,	July 10	3	3	Do. 3 p.c. Deb.	59—62	..	61—61½
734,000	,,	Sept. 11	6½	6½	Do. 6½ p.c. Red. Db.	99—102	..	101—101½
91,500	,,	Aug. 14	8½	8½	South Shields Con.	105—107d	..	..
1,543,795	,,	July 24	6½	6½	South Suburban Ord. 5 p.c.	100—103	..	..
468,837	,,	June 26	5	5	Do. 5 p.c. Deb.	95—98	..	..
647,740	,,	Aug. 28	5	5	Southampton Ord. 5 p.c. max.	75—78	..	..
121,275	,,	June 26	4	4	Do. 4 p.c. Deb.	73—76	..	..
179,014	,,	July 24	8	8	Sutton Ord.	110—113	..	..
94,500	,,	June 26	5	5	Do. 5 p.c. Deb.	93—96	..	..
250,000	,,	Aug. 28	7	7	Swansea 7 p.c. Red. Pref.	98—101	..	..
200,000	,,	June 26	6½	6½	Do. 6½ p.c. Red. Deb.	98—101	..	..
1,076,490	,,	July 24	6½	6½	Tottenham District Ord.	102—106	..	103—105
150,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	95—98	..	..
199,005	,,	June 26	4	4	Do. 4 p.c. Deb.	75—78	..	..
182,380	10	30 Dec., '12	—	—	Tuscan, Ltd.	3¾—4¾	..	..
85,701	Stk.	Sept. 25	6	6	Do. 6 p.c. Red. Deb.	73—75*	..	74½—75
309,094	,,	Aug. 28	7	7	Uxbridge, Maidenhead, & Wycombe 5 p.c.	95—100	..	..
88,330	,,	,,	5	5	Do. 5 p.c. pref.	85—90	..	..
1,180,970	,,	July 10	—	7	Wandsworth, Wimbledon, and Epsom Cons.	107—112	..	109—110½
200,000	,,	,,	5	5	Do. 5 p.c. Pref.	90—93	+1	91—92
488,344	,,	June 26	5	5	Do. 5 p.c. Deb.	98—101	+1	98—99½

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Two 30 ft. × 8 ft. 6 ins. ×	160 lbs.	6983/4
One 30 ft. × 8 ft. 3 ins. ×	160 lbs.	7018
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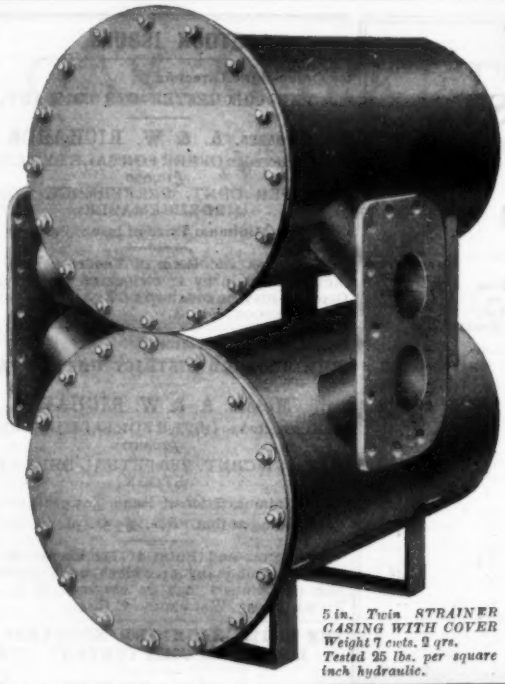

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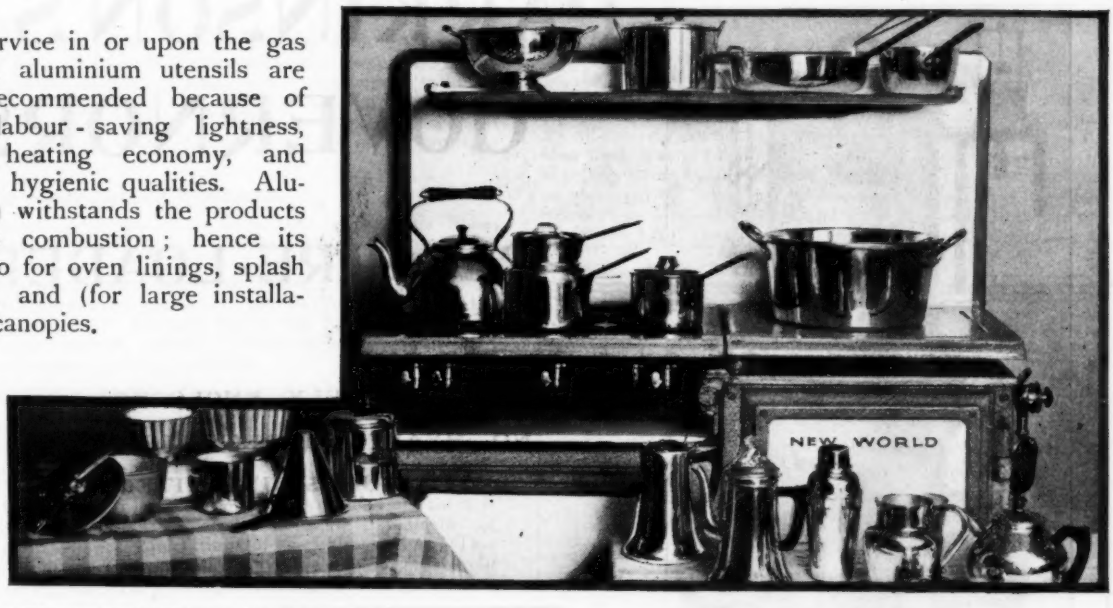

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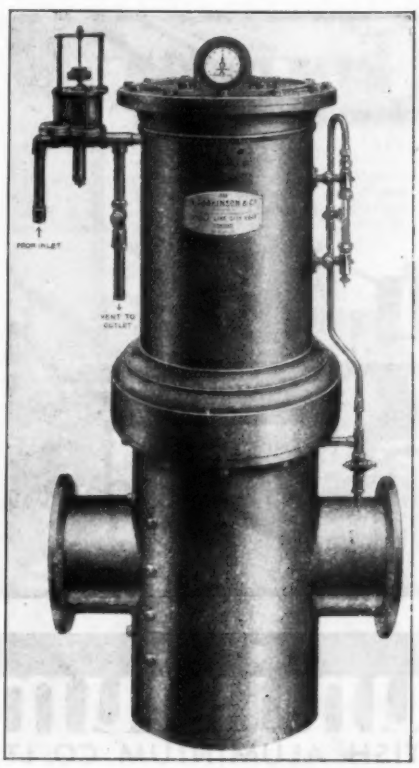

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